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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

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In support of the proposition in Ohio and other states to reduce by law passenger rates to 2 cents—or less—per mile, the "voluntary" decision of the New York, New Haven & Hartford fixing the two-cent rate has over and over again been cited. The facts, historical and present, may therefore fitly be stated with their proper qualifications. In the year 1886 the New Haven directorate, when President Watrous was head of the corporation, voted to reduce the regular fare to 2 cents a mile on the main line between New York and Springfield, Mass., and to 2½ cents a mile on the Shore Line and Air Line divisions, then under lease. Last Saturday the directors of the company voted to reduce the regular rate of 2½ cents a mile on the Berkshire division to 2 cents a mile and to consider later a similar reduction on the Naugatuck and Northampton divisions. There has thus been an interval of almost twenty years during which the *regular* rate, as we understand it, has remained satisfactorily unchanged, notwithstanding the immense growth of the system and of the volume of passenger traffic and the definition of the New Haven's "trunk" line under the Connecticut statute as including 114 miles of double track between New Haven and Providence in addition to the old "main" line between New York and Springfield. In fact, the company now charges on its through system for the 232 miles between New York and Boston $5, or 2.15 cents a mile; and it will be noticed that last Saturday's action of the directors does not affect its Eastern business. We do not, of course, overlook the fact that during the twenty-year period referred to the company has fixed a general 2-cent rate by mileage books—1,000 miles on the whole system and 500 miles in Connecticut—but this has not been the "regular" rate, nor is it now. We have not the slightest doubt that the New Haven has found the reductions both wise and profitable, and that continued reductions will be in the end remunerative. But the facts remain writ large that reductions of the regular rate have tarried long, that they have not been general and are not so now, and that they have been, in the main, differentiated according to density of passenger traffic on the various parts of a railroad system which is far and away ahead of all others of the country in the size of its average passenger trainload. It is a very different case from the sweeping and indiscriminate imposition of the 2-cent rate as a maximum on railroad lines of all kinds in a large state with, relatively speaking, very low passenger density. Instead of being arguments for such a proposition, the whole history and policy of the New Haven Company strike in a line diametrically opposite.

ANOTHER RAIL MOTOR CAR

Another design of gasolene-electric rail motor car is described in another column, and it is quite similar to the car designed by the General Electric Company for the Delaware & Hudson, illustrated in the *Railroad Gazette*, February 9. These two cars, of the same general type, represent one effort in the direction of producing a satisfactory rail auto-car; the Union Pacific gasolene motor car represents another, and the steam motor cars, now in extensive use in England, but as yet untried in this country, represent still a third method. The gasolene motor cars on the North Eastern Railway and all those built in this country are still some little way removed from unqualified success. They are interesting experiments but as yet of little practical value for actual service. The gasolene engine has made wonderful progress within the last few years, due largely to the development of the automobile, and it is not surprising that the results obtained with road vehicles of moderate power have attracted and held the attention and efforts of many of those who have been trying to work out the more difficult problem of railroad motor cars. If the gasolene cars have one common fault, it is that they are underpowered. It is a difficult matter to build an engine of sufficient power to drive a car continuously at a speed of 30 or 40 miles an hour over a road of average grades and to keep the size and weight down to reasonable limits. Automobiles of 200 h. p. are talked about, but they are myths. Increasing the size and multiplying the number of cylinders will not increase the power of the engine in direct proportion unless the adjustment of the valves and ignition is perfect. And it must be remembered that the power of the prime mover does not by any means represent the power delivered at the wheels. The engine in the Delaware & Hudson car runs at 450 r. p. m., and has six 9-in. x 10-in. cylinders. It is said to be the most powerful unit of its kind built, but it develops only 160 brake horse-power, which means about 130 horse-power delivered at the wheels when every part of the apparatus is in perfect working order. On fairly level track and in

the absence of strong head winds the car maintained an average speed of 35 miles an hour and a maximum speed of 40 miles an hour. A gas engine cannot be forced beyond its full capacity as can a steam boiler, and as it has no reserve power, the slightest unfavorable circumstance means a considerable falling off in the speed. The gasolene-electric combination gives smooth and easy control, and in connection with storage batteries some reserve power for accelerating or climbing grades, but at the expense of added weight and first cost of the apparatus. The Union Pacific cars have not yet had a fair trial to test the wearing qualities of the direct transmission gear employed. If it proves entirely successful, the introduction of a generator and motors on the axles to transmit the power from the engine to the wheels would seem to be a useless complication which has few advantages to offset its additional weight and cost. It seems strange, in view of the interest which is manifested in rail motor cars in this country, that no road has as yet made serious experiments with steam cars using a flash boiler. The prevalent—almost universal—type of car with which experiments have been made in England during the last two years does not differ in any material particular from a little locomotive with an upright boiler, and a car built around it. It is safe to say that these cars are not a success, and the Great Western (England), which was foremost in its experiments, has now discontinued building them. The reasons for this are plain: the upright-boiler locomotive has no advantage over any other small locomotive, except, perhaps, in minute fuel economy; there is no economy in train crew, and a locomotive temporarily out of commission means a car out of commission also, as Mr. Forney used to point out in these columns. The North-Eastern is now experimenting with light locomotives coupled to a single car with a device which permits driving from either end. This saves new first cost and gives separate units, but introduces no special working economies.

Meantime, the automobile makers are contributing every day to the practical designing of gas engines and flash-boiler steam engines. It seems reasonable to suppose that it will be only a question of time—and no very long time at that—before they can produce a car capable of picking up its load at the start.

A NEW POINT IN THE INTERSTATE COMMERCE ACT.*

The Supreme Court of the United States on February 19, with an undivided bench, handed down a decision which looks as if it might be important and far reaching in its interpretation of the Interstate Commerce Law. The case arose in a suit instituted in the United States Circuit Court of the District of West Virginia by the Interstate Commerce Commission to enjoin the carrying out of a contract under which the Chesapeake & Ohio Railway Company agreed to deliver at New Haven 60,000 tons of New River coal for the New York, New Haven & Hartford at $2.75 per ton. The price of coal at the mines, plus the cost of transportation from Newport News to New Haven, was $2.47 per ton, while the published rate from the mine to Newport News was $1.45 per ton, and the bill was based on the claim that this was in effect a discrimination in that the company carried the coal for less than the usual rates. The company denied this and alleged that it was a loss it sustained on the price of the coal, and that it took these means to reimburse the New Haven road for something over $100,000 which the New Haven had lost through the inability of the Cheasapeake & Ohio to fill a previous contract, owing to a strike of miners.

The Circuit Court held that there was no violation of the rebate provision of the Interstate Commerce Act, but held that the contract between the two roads was illegal and enjoined its enforcement. Both railroads and the Commission appealed. In the course of a long decision Justice White says: "We find it impossible to conclude from the proof that the Chesapeake & Ohio could have made a contract for so large an amount of coal to be delivered over so long a period without taking into view the existing prices, and the cost necessarily to be occasioned by the delivery of the coal if the full published freight rates were to be realized. Indeed, the proof leaves no doubt upon our minds that in making the contract the Chesapeake & Ohio sought to accomplish results which it deemed beneficial by means which it considered effectual, even although resort to such means was prohibited by the Interstate Commerce Act. * * * We think it is shown that the mode of delivery adopted was simply the result of a disregard by the Chesapeake & Ohio of the economic conceptions upon which the Interstate Commerce Law rests, and a substitution in their stead of the conceptions of the Chesapeake & Ohio as to what was best for itself and for the public. Further, as the prohibition of the Interstate Commerce Act is ever operative, even if the facts established that at the particular time the contract was made, considering the then cost of coal and other proper items, the net published tariff of rates would have been realized by the Chesapeake & Ohio from the contract, which is not the case, it is apparent that the deliveries under contract came under the prohibition of the statute whenever for any cause, such as the increased cost of the coal at the mines, an increase in the cost of the ocean carriage, etc., the gross sum realized was not sufficient to net the Chesapeake & Ohio its published tariff of rates. * * * As the court below did not decide that the second and sixth sections of the Act relating to the maintenance of rates had been violated, the injunction by it issued was not made as directly responsive to the comments of the statute on that subject as we think it should have been. We therefore conclude that the injunction below should be modified and enlarged by perpetually enjoining the Chesapeake & Ohio from taking less than the rates fixed in its published tariff of freight rates by means of dealing in the purchase and sale of coal, and as thus modified the decree below is affirmed."

In the earlier part of the decision the court expands the principle expressed in the last paragraph, and it brings out very clearly the point that if, by the mere fact of purchasing and selling merchandise to be transported a carrier is endowed with the power of disregarding the published rate, the carrier then possesses the right to treat the owners of like commodities by entirely different rules, selecting the favored persons from whom it would buy and the favored persons to whom it would sell, thus giving such persons an advantage over every other and leading to a monopolization in the hands of such persons of all the productions in which the carrier chose to deal.

To the non-legal mind this seems a perfectly sound exposition of the principles laid down in the Interstate Commerce Act, and it has for a long time been pretty certain that some of the suits pending would develop this situation, or something like it, although the actual breadth and scope of the decision which the court handed down is said to have surprised even the attorneys who argued the case. It remains to determine what the effect of the decision will be on coal railroads which haul their own coal and upon private car lines, if these are declared common carriers by congressional act, as it now seems quite likely that they will be. A number of critics have said that this decision will prevent coal roads from owning coal mines and beef packers from owning refrigerator cars. We do not believe that this is so. If it is, it is not so by virtue of the present decision, for the matter at issue deals only with the entire rate for product plus transportation. If this rate is such that any one can buy the product at the market price and deliver it to a customer, after paying the rail rate, as cheaply as the railroads or car lines themselves can do so, then the principle laid down by the court is apparently not violated. This is as it should be.

But right here comes in a very interesting and perplexing question, which shows what the law has to contend with when it concerns itself with the very broad principles of the Interstate Commerce Act in extension. Suppose a coal company, which has no apparent connection with a railroad, makes a wholesale rate very much lower than its retail rate provided a sufficiently large quantity of its commodity is bought at one time. We believe that this would not conflict with any existing statute. Suppose, then, that only one customer is so situated that it can take advantage of that rate, that customer being a railroad. What is to prevent the coal company from making a "midnight tariff" for the railroad whenever it seems expedient—and, if it does so, how will the result be any different from the present situation? We do not know whether it would be or not. We merely suggest this as one of the interesting possibilities which this novel and very far reaching case appears to bring up.

*The decision of the United States Circuit Court on this case (which is now affirmed) was reported in the *Railroad Gazette*, of Feb. 5, 1904, page 102.

COLLECTING TICKETS AND CASH FARES.

It was announced in Houston, Tex., the other day that one of the railroads entering that city which for a year or so had had on its passenger trains collectors, who had been put on to relieve the conductors and leave them free to attend to the safe and prompt movement of their trains, had taken them off; and, at the same time, it was announced that one of the other railroads had just decided to put a large number of collectors on. This epitomizes a

considerable number of news items that have appeared in the newspapers during the past dozen years; collectors are put on and taken off, and put on again, and no one seems to have a settled opinion whether it is or is not profitable to employ them. What is the reason for this? Do we not yet understand the essential conditions of the business of collecting tickets and fares?

Let us admit at the outset that there is no great weight in the argument that we ought to partly relieve the conductors to prevent collisions. Collectors are put on to stop or reduce stealing. A level headed conductor has no trouble in attending to safety first and cash and tickets second. Relieving him of work is more likely to entail the same difficulty as putting a third man on the engine, the difficulty of holding him to the infrequent duties that still rest on him. Conductors who by neglect cause collisions seldom convince anybody that overwork in other things was the real cause of the trouble; and the true remedy for collisions does not lie in this direction at all; it is to be found in connection with the signaling and the lookout on the engine.

We must also admit that on heavy trains doing local business the best conductor or collector in the world will miss some fares. As long as there are dishonest passengers this will be a penalty of our slipshod way of admitting people to the trains without collecting their tickets when they enter. Again, we must recognize that we cannot make all conductors or collectors honest; and if a superintendent were to begin with a force of honest conductors he would have a duty not to unnecessarily tempt them to become dishonest.

So much concerning what we should not or cannot do. What we should do is reasonably simple, if we take time enough and spend money enough. Many a superintendent west of the Mississippi has said that he could not do as well in this matter as his eastern friends, because of the smaller number of men from which to select efficient and reliable conductors. While this point cannot be ignored, it is proper to suggest that bank cashiers seem to be as reliable in Idaho and Arizona as in Ohio or Maine. But whether one does or does not have the time and money necessary to accomplish ideal conditions there are a few simple principles that would seem to be generally applicable whether dealing with a railroad in the wilderness or one in New York or Chicago.

For practical purposes the prevention of stealing and the prevention of mistakes may be treated as one and the same thing. The bank examiners deal with an honest cashier the same as with one suspected of dishonesty. If a railroad superintendent is not ready to expend the necessary care and money to deal strictly with all his conductors he need not feel disappointed if he has friction in trying to discipline a part of them. To prevent mistakes, in a business where some mistakes are inevitable, it is necessary to enforce as many habitual safeguards as possible; habitual as against occasional. Tickets as well as cash should be closely watched. Tickets turned in to the accounting office by conductors should be examined without delay. Tickets which can be profitably handled by scalpers or traded in by passengers should be limited to as few days as practicable; so that when 100 tickets of a certain form have been sold on a given day it will be possible to find out quickly whether or not all of them have been promptly used and turned in. To so arrange tickets that the passenger will have the least possible temptation to misuse them and the conductor the least possible temptation to do anything but promptly turn them in helps to promote honest habits; and habits help to govern action. Habits of accuracy tend to promote habits of honesty. One of the disadvantages of the coupon mileage ticket is that it is easy to make mistakes with it. Accidental mistakes often lead to voluntary "mistakes."

In collecting cash fares the duplex receipt and the 10 cent rebate are generally regarded as essential. Beyond this there is no check except such as may be effected by requiring the practice of habits of accuracy to the utmost possible extent. All those exceptional situations in which it is necessary to allow conductors to collect the net fare, or omit the receipt, should be the subject of constant watchfulness and care.

In surprise checking the main thing is to get reliable checkers, which is by no means easy. One trustworthy "spotter" is better than a dozen who think that their main duty is to discover something wrong. Surprise checking is necessary, if it does not discover more than one thief in ten years, for prevention, not cure, is the desideratum. It must be admitted that—so loose is our system—all of the precautions mentioned in the foregoing paragraphs are insufficient without surprise checking.

While thus constantly watching for thievery, we must try to secure men whose self-respect and desire to be reputable citizens will keep them above stealing. It is important so to explain the ethics of surprise checking that these men will understand that it casts no aspersion upon them. The only systematic way to detect misconduct in any conductor is to watch the conduct, good and bad, of all conductors.

To train a man in habits of accuracy—which, as we have said, is an important element in training for honesty—it is necessary to begin when he is young; long before he is fit to entrust with a passenger train. A clerkship in a station or the general offices is a much more favorable place for thus training a young man than is a freight train. Native honesty may be as strong, or even stronger, in the brakemen; but the training which confirms the mental and moral traits must be found in fiduciary practice. It may as well be admitted, also, that politeness, another important element in a passenger man's training, can be cultivated on a freight train only under decided disadvantages. These considerations afford a strong argument in favor of having special collectors to take tickets and fares. If we desire to have the freight man for a passenger conductor because of his experience, we must, as a rule, put up with a man somewhat less qualified to deal with passengers than would be a man from an office. In view of the very small number of brakemen that we see on many passenger trains nowadays, we are not going to argue against the employment of collectors; there is too much evidence of the need of more men on trains, for the purpose of attending to the wants of passengers; we will content ourselves with the observation that whatever number of men is employed, and of whatever grade, every one of them should be made useful in promoting the comfort of passengers. One prominent eastern road has given up the attempt to make polished gentlemen out of freight conductors, and recruits its passenger train forces—beginning with passenger brakemen—from other classes. The difference between freight cabooses and "varnished cars" is frankly recognized. The policy is made acceptable to the freight conductors by arranging their work so that they earn about as much pay as do the passenger men. Assuming, as we must assume, that the men who are put in charge of passenger trains are properly trained for all of their duties, this policy disposes of one of the obstacles to securing satisfactory men to collect fares and tickets. If we eliminate the long period of freight-train service there should be time to train men in accuracy, honesty and train-management before they are too old to be put in charge of passenger trains. When the block system is in use everywhere the training of an office man to take charge of a train will be a less tedious task than it is at present.

If the views which we have here expressed are correct, we may fairly sum up by saying that the man to collect fares should have the two essential qualifications of honesty and politeness: and that as a means of securing these the superintendent should take an interest in a third qualification, civic pride—if we may use so ambitious a term. It is necessary to seek men who not only have some moral character but who intend to cultivate the moral virtues. If men with these qualities cannot be trained up in the freight train service we must train them in some other way. If we must have two men on a train where we should prefer to get along with one, we can use the two to give passengers more efficient and pleasing personal attention. However high the character of the men, constant discipline in accuracy is proper and necessary. Discipline in accuracy is as near as we can get to discipline in honesty.

January Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of January, printed in another column, contains accounts of 29 collisions, 23 derailments and one other accident. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

	Place.	Killed.	Injured.
3d	Chicago, Ill.	0	10
5th	Palisade, Nev.	1	11
6th	Corry, Pa.	3	8
11th	St. Louis	0	9
13th	Lawrenceburg, Ky.	1	4
23d	Glendora, Cal.	0	15
24th	Ore Hill, Conn.	2	0
29th	Edelstein, Ill.	4	0
30th	Columbia, S. C.	4	3

Two of these accidents, Glendora and Edelstein, are reported as having been due to failures in block working. The derailment at St. Louis affords an interesting instance for comparison with the disastrous derailment on the Elevated road in New York City a few

months ago. The cases are alike, in that in both of them a passenger car fell, about 15 ft., from the track to the pavement of the street; but they are unlike in that in the St. Louis case no person was killed. This favorable outcome may be partly due to the negative fact that only a few people were in the car; but it is pleasanter to dwell on the positive fact that the great strength of the car framing was undoubtedly an essential element in the saving of these 13 passengers' lives.

The first item, Chicago, emphasizes the fact that the occurrence of injuries to passengers does not always imply something wrong in our provision for the safety of passengers; for these 10 men—drovers, no doubt—were in a freight caboose. The Interstate Commerce Commission has lately introduced in its accident bulletins a change that will produce instructive results on this point: men riding on a train to take charge of freight, together with mail clerks, express messengers and other classes who are lawfully on a train but are neither employees nor regular passengers, are put in a separate class, distinct from regular passengers in passenger trains. If regular passengers riding in freight cabooses were also segregated in the Government reports we should see a still further diminution of the totals in the first column of the casualty tables. A railroad is bound, of course, to see to the safety of all persons lawfully riding on its trains, including employees; and the separating of persons into different classes in the tabulations is not advocated by any one with the idea of showing more or less blame or responsibility in any given case. But with casualty reports as ordinarily made, in which the reader is likely to assume that all of the "passengers" were riding in passenger cars on regular passenger trains, most people are likely to jump at the conclusion that the deaths and injuries—whether the number be small or great—have occurred in spite of the exercise of the highest care of which the railroad is capable. Such a conclusion is in some degree erroneous; for, irrespective of the care taken by the trainmen or the intelligence of the provisions for safety made by the company, the dangers of travel are inevitably somewhat greater on freight trains than on passenger.

The second accident, Palisades, illustrates another phase of passenger travel which has lately become prominent—the fact that a large number of persons may suffer in a passenger train collision or a derailment, while yet no passenger is injured.

The number of electric car accidents reported in the newspapers of the United States in the month of January was nine, in which four persons were killed and 56 injured.

After sinking some 300 million dollars in the Siberian Railroad, Russia, if recent reports are true, is likely to gain more wealth than from all Siberia from its extreme northeastern European government, now unavailable for the lack of three or four hundred miles of railroad. There, in the valley of the Pechora, and especially on its little tributary the Uchta, north of the 63d parallel, about 300 miles south of the Arctic, as far northeast of the navigable Dwina river, and 400 miles east by south from Archangel, in an uninhabited wilderness, have been found (so Russian newspapers say) stores of petroleum which promise to exceed in quantity the fields on the Caspian, while much superior in quality. The Caspian petroleum, by the way, is heavy, and yields per barrel only about half as much illuminating oil as the American crude oil. But this is not all: the same country is full of copper mines, from which millions of tons of ore may be extracted. We are not accustomed in this country to find petroleum and copper in juxtaposition; but this is in Russia, and on the edge of the Arctic zone. Unfortunately it is impossible to draw on these treasures at present; for they are almost inaccessible, and there is no one in the country to do the work. A pipe line to the Dwina would give outlet for the oil to the port of Archangel, which has a considerable and increasing trade, chiefly with England; but it would not bring men and supplies in. About 400 miles of railroad will be necessary for this, connecting with a new line from St. Petersburg eastward. This the state is asked to build. It pretends that it has something else to do just at present. A company with a capital of less than $3,000,000 has been organized to develop these treasures, but at latest news had not had all its stock subscribed. This story may seem like a romance manufactured to bear Standard Oil and Amalgamated Copper stock; but it is probable that it is founded, at least in part, on fact. Baku petroleum specialists are reported to have examined the country and to be enthusiastic over the prospects.

The German iron-masters do not favor any general cheapening of passenger fares, arguing that these are already so low that they hardly exceed the bare cost, and that a reduction in freight rates, which would permit a greater growth of manufacturing industries, would be of much more value to the laboring population than any reduction in the cost of travel. One man has been to the trouble to separate passenger and freight expenses, as nearly as possible, on the basis adopted in this country; and has found that passenger expenses absorb 92 per cent. of the passenger earnings of the Prussian State Railroads, while 49 per cent. of the freight earnings are net. At a meeting of representatives of German blast furnaces Dec. 3, one of the speakers affirmed that on the average 23 to 24 per cent. of the cost of producing pig iron in Germany went for railroad freight charges, which have been reduced comparatively little in course of years; while in America, where in 1876 Sir Lowthian Bell found that the cost of transportation for materials for a ton of pig were $8.33 at Pittsburg it has been reduced to $2.34. This speaker drew the conclusion that in dull times America will make the prices of pig iron for the whole world, and unless the German iron-masters can secure lower freights, they will be driven out of the market at such times.

TRADE CATALOGUES.

In 1894, the Master Car Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. The advantages of conforming to these sizes have been recognized, not only by railroad men, but outside of railroad circles, and many engineers make a practice of immediately consigning to the waste basket all catalogues that do not come within a very narrow margin of these standard sizes. They are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

Standards.	
Postal-card circulars	3¾ in. by 6⅛ in.
Pamphlets and trade catalogues	3½ " by 6 "
	6 " by 9 "
	9 " by 12 "
Specifications and letter paper	8¼ " by 10¾ "

The General Railway Signal Co., Buffalo, N. Y., has issued the second section of its catalogue and price list—the section which deals with mechanical interlocking. This is a book of 480 pages, 6 in. x 9 in., and both the letter press and the drawings are large and plain, affording the maximum of convenience to the reader. This company, with the large and well equipped shops which fell to it when it absorbed the Pneumatic Signal Company, is well prepared to make everything in the mechanical interlocking line; and this catalogue describes interlocking machines, both with vertical and with horizontal locking; all kinds of leadout and ground connections, switch-and-lock movements in ample variety, bridge locks and everything that is in demand. Self-contained electric motor signals are recommended for distant signals with mechanical plants, and everything in connection with these signals and with electric locking is shown. The lists of articles, always on the page opposite the drawings of the same articles, are printed in large type, and every descriptive clause which is not short has the principal words printed in full faced capitals, making a convenient "short title" for use in ordering. Besides the regular index, there is an index to pattern numbers, enabling the reader quickly to find the order number of any casting of which he knows the number.

Steam Engines.—"Allis-Chalmers Engines—At Home and Abroad," is the title of a 68 page bulletin about to be issued by the Allis-Chalmers Co., Milwaukee, Wis. The title page illustration represents four engines, capable of furnishing 35,000 h.p., installed in the power-house of the Twin City Rapid Transit Co., Minneapolis. A number of other large railway power-stations in which Allis-Chalmers engines are used are also illustrated. Illustrations of its pumping and blowing engines, as well as of air compressors and hoisting engines which are installed in some of the largest municipal and industrial plants in this country, are also given.

Water Filtration.—Four interesting pamphlets bearing the following titles are published by the Pittsburg Filter Mfg. Co., Pittsburg, Pa. "Mechanical Filtration," "Efficiency of Mechanical Filters," "The Purification of Water from a Sanitary Standpoint," and "Water Filtration and its Relation to Municipal Health and Prosperity, with some Statistics of Typhoid Fever Epidemics."

Tents and Awnings.—The United States Tent & Awning Co., Chicago, sends its 40-page pamphlet catalogue, describing and illustrating its large line of tents and awnings. A full list of sizes and prices for different qualities of materials is given. The list also includes cots, paulins, flags, horse covers, etc.

CONTRIBUTIONS

Weak Cars in Passenger Trains.

Worcester, Mass., Feb. 17, 1906.

To the Editor of the Railroad Gazette:

Gentlemen:—I was a passenger on the Pacific express (Boston & Albany Railroad) which entered into collision on Thursday evening last, in the Boston yard. The cause of the collision will probably be cleared up as another case of inevitable human fallibility. But the cause of the loss of life and limb cannot be so disposed of. That was plainly due, in my opinion, to the improper use of old and

weaker cars in the middle of a modern heavy train. The train consisted of two modern baggage and express cars immediately behind the locomotive; then followed two cars of the 1860 pattern filled with emigrants; then followed two modern day coaches, one of them vestibuled, and two or three sleepers. The collision was an insignificant bump. The train had just pulled out of Trinity Place station and had acquired but little headway (the locomotive and forward cars only had passed Huntington avenue), and the brakes had been on hard for several seconds before the crash came. The locomotive and two forward cars were practically unharmed, but the baggage car was telescoped into the forward emigrant car.

It is my opinion that had the train been composed either of all modern cars or of all old cars, no loss of life would have occurred. In the former case probably nothing would have smashed; or if it did, it would have been one of the baggage cars. In the latter case the inertia would have been so much less that probably nothing would have crumpled; or if it did, it would have been the baggage cars again.

SIDNEY A. REEVE.

Functions of a Good Draft Gear.

BY A. STUCKI.

Ask the man on the repair track, "What part have you to repair the most?" and he will answer, "The draft rigging." Is it a wonder, if we consider that this detail has to be yielding; that all the heavy blows and shocks are concentrated at that point and are from there transmitted to the car?

These blows get heavier every year. The trainmen know that the steel cars can stand more punishment than their wooden predecessors, and have a decided tendency to handle them accordingly. The switchmen in yards seem to be somewhat of the same opinion, judging from a recent expression from one railroad officer, "that sleeping within a mile and a half radius from a switching yard is out of the question." The locomotives are constantly increasing in weight; so are the cars. The number of cars in a train is double that of a few years ago and trains run at a higher speed. Is it any wonder that the old style draft gears fail under the new conditions of service? Even designs of recent date have failed quite frequently, and it may not be amiss to see what really does take place when two cars come together.

For convenience sake, let us first define the expressions most used hereafter:

Capacity = Pressure at the point the gear becomes solid.
Recoil = Pressure at the point the gear starts to recede.
Whole work = Energy temporarily absorbed during the stroke.
Work given off = Energy given off during the return stroke.
Work absorbed = Energy permanently absorbed.
Impact = Maximum pressure due to energy left unabsorbed by the whole work done.

It will be noticed that this leaves the usual meaning of "capacity" and "recoil" intact.

In a general way the functions of a draft gear are to absorb energy and to transmit part of the excess energy safely to the car. In order to permanently absorb as much work or energy as possible, it is necessary to have a high capacity, a long stroke, and a low recoil. Until comparatively a few years ago one standard spring of 19,000 lbs. capacity was all that was required. As the cars got heavier, two such springs were found to be necessary, either side by side or in tandem, and both types are extensively used today. However, some of the railroads, desirous of protecting their rolling stock as much as possible, did not stop there; some tried triple and others quadruple springs to suit the changed condition of the service, but this made at the best only 4 x 19,000 or 76,000 lbs. elastic resistance, which was still considered insufficient, and objectionable in other respects. At this period, for the first time, the friction draft gear made its appearance and at once attracted the attention of railroad men because among other advantages it made it possible to obtain a capacity of 150,000 lbs. and more.

Since that time, friction has been made use of in innumerable different ways and constructions, thereby using the different mechanical elements, such as the wedge, the cam, key, eccentric, lever, torsion, leaf springs, coil springs, dampened or otherwise, plain pressure or plain or grooved surfaces, the inclined plane, etc., etc., but in an article of this sort it would lead too far to describe in detail the construction of these respective gears.

The longer the stroke the greater is the whole work done, everything else being equal. With the standard 6¼-in. x 8-in. spring the stroke is 1¾ in., ¼ in. initial compression being allowed; and the stroke naturally remains unchanged, even if the springs are arranged side by side or in tandem. When the friction draft gear was introduced, this motion was increased and the majority of gears of that type adhere to 2⅝ in. This dimension has not been exceeded as yet, and the reason why it cannot very well be done is the fact that the overhang of the coupler, already great, would become excessive, especially when under tension. We have already gone pretty far in allowing the coupler head, weighing possibly 200 lbs., to overhang a foot or more beyond the center of the carry iron. This overhang is more serious if we consider that the connection between the coupler and the yoke is not always secure, which has a tendency to throw more weight on the carry iron. Often only four bolts in tension (none in shear) are used to fasten the carry iron to take the weight of the couplers and the vertical chafing between two adjoining cars. It is self-evident that the motion of the draft rigging could be increased beyond 2⅝ in., provided a more substantial support or suspension of the coupler is devised. This increase in stroke would increase the whole work done by the draft gear.

The recoil in the different gears varies even more than the capacity, at least in proportion. Roughly speaking, it should be small, so as not to re-act on the car as soon as the latter is through taking the impact. On the other hand, a certain amount should always be present to insure the proper return of the gear into its normal condition, else lost motion will take place between the followers and the yoke, with results far more serious than those of a recoil too large. This point should be watched very carefully, especially so since some friction gears in service may change their bearing surfaces, which affects the friction and causes the sliding parts to stick.

Let us now take up a specific case in order to see what really does take place during the time the cars come together. Suppose that a loaded train runs into a loaded car standing still. Speeds of 13 and even 15 miles an hour have sometimes been assumed in this connection, but let us assume a speed of eight miles an hour, which is usually made the basis of tests in this field.

The weight per car being taken as 40,000 lbs., and the load as 100,000 lbs., the total weight (w) is 140,000 lbs. The velocity (v), eight miles an hour, is very close to 12 ft. a second. This gives an energy stored up in one moving car equal to

$$\frac{wv^2}{2g} \text{ or } \frac{140{,}000 \times 12^2}{2 \times 32.16} \text{ or } 313{,}450 \text{ foot pounds.}$$

g = acceleration of gravity, being taken as 32.16.

Let us further consider that the cars in turn are equipped with four types of gears which were tested for the Master Car Builders' Association at Purdue University in 1902, the first three being of the friction type; the last one being a spring gear. At the moment the respective gears became solid, i.e., have reached their capacity, the whole work done by two gears and the work left to be done by the car is as follows:

	Gear A.	B.	C.	D.
Whole work done in ft.-lbs. by two gears.	36,800	28,200	27,600	12,150
Work left to be transmitted to standing car in ft.-lbs.	188,325	142,625	142,925	150,650
Per cent. of work done by the draft gear	23.5	18.1	17.6	7.8

The figures for the work done are derived from the tests above mentioned, and the work left to be transmitted is obtained by subtracting the whole work done from the whole energy, i.e., 313,450 foot pounds, divided by two, inasmuch as only half of the energy need be transmitted to the standing car to result in a uniform speed for the two colliding cars.

The impact now depends upon the rigidity and stiffness of the car, and it is natural that the less the latter yields the harder the blow will be. If the cars, or even only one of them is a wooden one, the dynamometer car will not register as high as with a rigid steel frame.

After the impact has taken place, the draft gear is free to expand to its usual condition, and in so doing will give off a certain part of the work in the return stroke. Taking the same gears as above, we find the following:

	Gear A.	B.	C.	D.
Work given off in ft.-lbs.	3,466	4,400	4,800	10,400
Work absorbed in ft.-lbs.	33,332	23,800	22,800	1,750
Absorption in per cent. of total energy	21.3	15.2	14.5	1.2

The movement of the standing car during the closing of the two gears has not been taken into consideration. It is, however, very small. A draft gear with a capacity of 150,000 lbs., uniformly increasing from zero and with a stroke of 2⅝ in., will have a movement of about $^1/_{40}$ in., which is entirely negligible. This is due to the enormous speed of the moving car and the absence of any motion with the standing car. These conditions will naturally change when the difference of speed of two approaching cars is smaller. Then a considerable movement of the slower car takes place between the time the couplers meet and the moment the draft gears become solid. This movement assists the draft gears.

From what has been said, it will be seen that the second function of the draft gear is an important one, and in providing for the transmission of this excess energy to the car we should always consider the most severe cases allowable in service. Unfortunately there is no stipulation or standard in this respect as yet, and we often hear of impacts registering from 300,000 to 600,000 lbs. At any rate it is well to make the draft gear as strong as the coupler, and the car stronger than either of the two.

The springs of a draft gear should not be exposed to the impact but should be protected from the time the gear reaches its

capacity. Otherwise these heavy blows are transmitted through surfaces of small area and a decided tendency exists to crush the material or to cause the coils to slip relative to each other. All other weak parts should be thrown out of action and the final blow should always be transmitted through the strong and solid parts. The writer has seen many serious mistakes made in this direction, and in every case subjecting the gear to actual service showed them up very quickly. It is interesting to point out that in figures quoted above the total work done by the draft rigging is in every case small, in comparison with what is left for the cars to take care of.

If it were possible to get as high a capacity in gear D as in the cases of the other types of gears, the impact would be the same and the car would absorb the same amount of energy. However, the work given off by the spring gear is nearly as great as the work done, hence in returning to its normal condition it would transmit another blow to the car, setting up a series of oscillations and jerks which would tend to shorten the life of the car and all its parts. Unfortunately service data cannot be obtained in this respect inasmuch as the inaccessible gears of two adjoining cars are always working together. In other words, it is one of your own and one of your neighbor's gears that protect your car, and unless cars are kept on special runs it is almost impossible to obtain accurate data in this respect.

There is another condition, in itself almost the reverse from that just mentioned, but the result is just as hard on the car, and has a tendency to rack it to pieces. This is always the case when the first portion of the stroke is too stiff, which means that the small waves constantly existing in a moving train are not taken care of by the draft gear but are transmitted to the car just the same as if the draft gear had been a solid block, and the gear cannot do its duty until the shocks are large enough to overcome the initial resistance.

A draft gear should be self-contained, i.e., it should not exert any side or other component pressure on the car frame, except in the direction of the center sills. By this no allusion is made to trifles, such as the weight of the gear itself. Whenever friction is used to augment the capacity of a draft gear, the bearing surfaces should be made large. By doing this the friction is not increased (for the amount of friction is independent of the size of bearing surface), but it is necessary to reduce the wear and increase the life of the gear. This point should be watched closely, especially in designs where large surfaces are hard to work in, as for example, in spring dampeners, where sometimes only one point bears and in cam motions where only a line is touching at one time.

It has already been mentioned that wear sometimes changes the shape of the friction elements, such as cams and keys, thereby affecting the original motion and either making the gear too stiff or too flexible. The natural suggestion would be to make the friction surfaces of such contours so that the wear, no matter how much there is, will not affect the shape and its subsequent working.

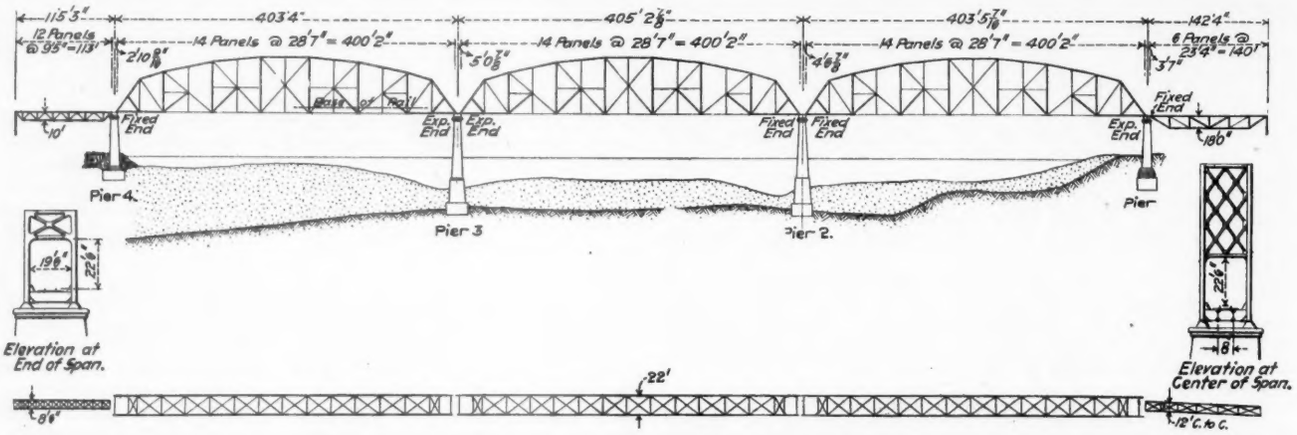
The Master Car Builders' Association has made the interchange of arcs possible or at least practicable, and through its efforts the whole question of rolling stock has immensely been simplified, not only for the railroads but for the car builder as well. Why not then assist these efforts and use such details as have been made standard or recommended practice; for instance, the yoke, followers, fillers, and springs? By doing this it will not be necessary for the railroads to carry so many different parts in stock. It will facilitate repair, and undoubtedly save a good deal of time.

Simplicity of construction is the fundamental principle in car building, and it applies to draft gears more than anything else. As between a draft gear containing 20 pieces and one doing exactly the same thing, but containing 10 pieces, there is only one choice. We may look at it from any side as to its life, first cost, method of manufacture, ease of repair, and find every advantage in favor of the simple device. For the same reason the different parts in themselves should not be of an intricate or delicate nature; they should be governed by the same rules as any other car casting.

New Bismarck Bridge of the Northern Pacific.

The Bismarck bridge of the Northern Pacific crosses the Missouri river just west of Bismarck, N. Dak. It is a single-track structure, carrying the main line of the railroad. The original bridge was built in 1882, and was designed for a train load of two 75-ton engines followed by a uniform load of 2,000 lbs. per foot. As it had become too light for present traffic, it was decided to replace it with a new structure during the summer of 1905. This work has just been completed.

The previous bridge consisted of three 400-ft. double intersection through pin spans, supported on four granite masonry piers across the main channel of the river, with one 113-ft. deck approach span at each end. It was built by the Detroit Bridge & Iron Works. As the masonry piers were in good condition, it was decided to use them for the new bridge, making such changes as were necessary for the changed bearings. The main spans, therefore, are the same length as before, but the east approach span, 113 ft. long, has been replaced with a new span 140 ft. long on account of the bank formation, which has a tendency to slide toward the river. The west approach span has been replaced with a new span of the same length as before. The new structure is designed for the Northern Pacific Railway standard loading of two 188½-ton engines followed by a uniform train load of 5,000 lbs. per foot of track. The main channel spans are designed with curved top chords, as seen by the illustrations, giving a much more pleasing effect than the older design. The approach spans are deck-riveted lattice spans. The contract for the fabrication of the new structure was let to the American Bridge Company, and the greater part of the work was done at its new Ambridge plant. The track stringers were made at the Detroit works.



Plan and Elevation of New Bismarck Bridge, Northern Pacific.

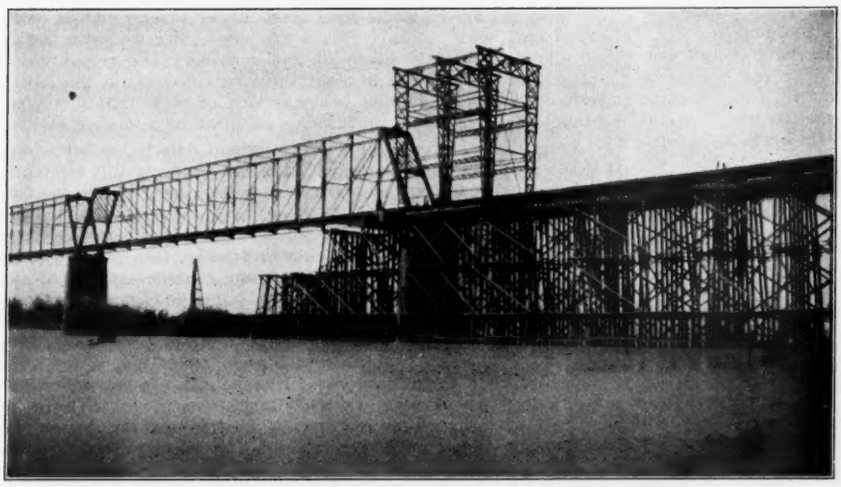
As it was necessary to maintain traffic across the bridge during construction, and as the traffic was expected to be unusually heavy on account of the exposition at Portland, Ore., it was decided that the railroad company itself would do the work of removing the old bridge and erecting the new one in its place, as it was believed they could do it with less probability of delay to traffic than if the work should be done by a contractor.

The bottom of the Missouri river, as is well known, is of a very unstable character, and sudden changes in the channel are to be expected. For this reason the original bridge had been erected on Howe trusses supported on intermediate temporary piers, as it was thought that ordinary falsework could not be maintained. In the erection of the new structure, however, it was decided to use the ordinary method of falsework supported on piles; and although the requirements of maintaining traffic and the erection of a heavier structure made it more difficult, it was successfully accomplished. The high-water stage of the river at Bismarck does not end until about the 10th of July, so no attempt was made to push the work before then; but after that date there is a steady decline in the high water of the river and force of the current. The force which had been previously organized was then largely increased, and the work was pushed vigorously until the last span was erected.

The 400-ft. spans were connected up and swung while under traffic. The approach spans were assembled on falsework alongside their permanent position and riveted up complete, and then moved into position between trains. The entire work of riveting the old

spans and erection of the new spans in their places was accomplished without accident and without materially interfering with traffic. The last span was moved into place December 25 last, the rapidity of erection under the conditions described being one of the notable points in connection with the bridge.

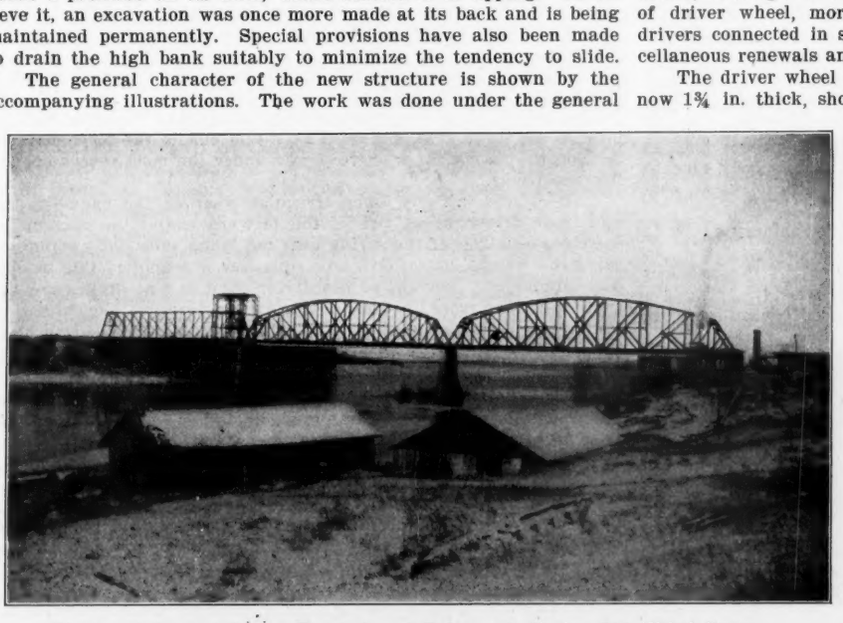
The tendency of the east bank to slide toward the river has been referred to. A short distance back from the river this bank rises to a height of about 100 ft. above the tracks. Some years ago this sliding tendency, in conjunction with the resultant earth pressure on its back, started the east pier to moving toward the river. Mr. George S. Morison undertook to restore it to its original position. First excavating back of it, he built under it a foundation of concrete, and interposed rollers between pier and foundation. When power was applied to the pier it moved back so rapidly that workmen in the excavation at its back barely had time to get out of its way.



Falsework and Traveler Used in Rebuilding the Bismarck Bridge.

Although the tendency of the pier to move bodily toward the river had been corrected, the sliding of the bank once more imposed a pressure on its back, which started it to tipping. To relieve it, an excavation was once more made at its back and is being maintained permanently. Special provisions have also been made to drain the high bank suitably to minimize the tendency to slide.

The general character of the new structure is shown by the accompanying illustrations. The work was done under the general direction of Mr. E. J. Pearson, then Chief Engineer of the Northern Pacific, by Mr. Ralph Modjeski, Consulting Engineer, Chicago, who designed the new structure, organized the forces in the field and had direct charge of the work. Mr. Ernest Nickerson was Resident Engineer at Bismarck, and Mr. James Saguin Superintendent of Erection.



First and Second Spans Erected and Falsework Under Old Third Span.

A press despatch from Tokio says that the Japanese Government has introduced in the Legislature a bill providing for the purchase by the state of 15 private railroads, which have an aggregate capital of $225,000,000.

Large Electric and Steam Locomotives.

At the February meeting of the New York Railroad Club, Mr. J. E. Muhlfeld, Superintendent of Motive Power of the Baltimore & Ohio, presented a paper on the subject of large locomotives. He gave a brief review of the work of the heavy electric engines used on the road. This consists, to a large extent, of helping on grades of from one to one and a half per cent. and over curves of from five to eleven degrees, with the mileage of 5,042 miles per month, about evenly divided between light and loaded service.

Considering $1.25 per net ton as a base cost for fuel delivered at the power plant, the average total operating and maintenance expenses during the year for generating the current; the labor and material for the locomotive electrical and mechanical repairs; the engineer's wages; wiping, hostlering, inspecting, oiling and despatching; lubricating and miscellaneous supplies, was approximately $34.50 per 100 miles run per locomotive. Of this amount the average cost of labor and material applied to each locomotive for the running and shop repairs, would be $3.20, or 52 per cent. for the electrical, and $2.90, or 48 per cent. for the mechanical, making a total average cost of $6.10 per 100 miles run for both the electrical and mechanical repairs.

The above figures do not take into consideration interest, depreciation, taxes nor insurance on the investment, nor do they include the expenses incident to the maintenance of such equipment as battery, feeders, third rail, bonding wires, insulation, safety cut-out switches, extra motors, etc., which is not required for steam locomotive operation. The wages for the conductor, or second man on the locomotive, have also been omitted.

During their service considerable difficulty has been experienced with the shoes used for collecting the current from the surface third rail; the loosening, wear and breakage of pinions used to transmit the power from the motors to the gears on the driver wheel axles; the lubrication, heating and wear at the armature bearings; the flange and tread wear of driver wheel tire; derailments; stalling and breaking in two of freight trains due to slipping of driver wheel, more especially with wet rail or when tire of drivers connected in series are not of exact diameters, and in miscellaneous renewals and shop repairs.

The driver wheel tires which when new were 2⅞ in. thick, are now 1¾ in. thick, showing only 7,500 miles run per $^1/_{16}$ in. metal removed at tread, and will have to be renewed within a few months.

The large steam locomotive dealt with was the Mallet compound, illustrated in the *Railroad Gazette* for September 4, 1903, and May 27, 1904. This engine was put in service on the Connellsville Division on January 6, 1905, and in the year that it has been at work it has developed that this subdivision of the power has resulted in less strain on all parts and reduced the liability to breakage; and also that while the wearing and total parts per locomotive are increased, they are greatly reduced when compared with the development of the same power by tandem locomotives, and the reduction in concentrated stresses and weight insures a more satisfactory and economical maintenance of those details most susceptible to depreciation.

The power of the engine is practically equal to that of two consolidation locomotives like those used on the division in question. The combined drawbar pull of the former is 79,400 lbs., while that of the Mallet compound No. 2400 is about 74,000 lbs. when working compound, and 84,000 lbs. when working simple. The weight of train that can be taken up the mountain by two of the consolidation locomotives is about 2,025 tons contained in loaded steel cars of 100,000 lbs. capacity. The weight of train that the 2,400 and one of the consolidation locomotives can take up the grade is about 3,210 tons, contained in similar cars. The above figures are based on the locomotives operating at a speed of 10 miles per hour under fair coal and weather conditions, and with the 2,400 working in compound gear.

The total elevation from Connellsville to Rockwood is 931 ft.,

the ruling grade between Confluence and Fort Hill being 1 per cent., and the total distance 43.4 miles.

In through freight service, from Connellsville to Rockwood, the 2,400, singly, has moved, in 36 steel cars, 1,668 tons of loading, and 702 tons of cars, or a total of 2,370 tons in the cars. Adding the weight in working order of the locomotive and averaging the weight of the tender loaded with coal and water at 225 tons, it would make the total weight of the train, including locomotive and tender, 2,594 tons, about 64.3 per cent. of which was paying load.

The actual running time was four hours, making an average speed of 10½ miles per hour. When handling this tonnage over the hardest pulls and around 8 degrees 30 minutes curvature, as high a rate of speed was maintained as with through freight trains of 1,200 tons total, when handled by consolidation locomotives.

Had this same train of cars been hauled by the standard consolidation type locomotive, it would have required the maximum hauling capacity of two locomotives to have handled it at the same rate of speed, and the average weight of the motive power would have been 304 tons, making the total tonnage of the train 2,674 tons, and about 62.4 per cent. of which would have been paying load.

When helping trains consisting of consolidation type pulling locomotive having tractive power of 39,700 lbs., with 40 cars consisting of about 2,400 tons, weight of lading and cars, the 2400 has pulled 36 of the 40 cars in the train on 3 and 4 degrees curvature, and 1 per cent. grade, making an average speed of about 4½ miles per hour, and has pushed the entire train and pulling locomotive, weighing about 2,550 tons, when the pulling locomotive was shut off, at a speed of 2 miles per hour, and maintained the working steam pressure and the normal water level for a distance of one-half mile on the same curvature and grade, and which performance could have been continued.

During the year the engine had made 44,976 miles at a total cost of labor and material per 100 miles run of $3.16. During the last six months it has been out of service eleven days for washing, staybolt testing and repairs, or about 6 per cent. of the time.

When working at Rockwood the locomotive remains in service for two or more weeks' period, and is then taken to Connellsville for a washout, staybolt test and the necessary inspection and running repair work.

Allowing for firebox and boiler tube renewals, heavy machinery repairs, etc., it is estimated from the last year's performance that at the end of ten years the shop charges for working repairs will have averaged not to exceed 9 cents per mile run.

When operating over combination, level and mountain divisions, No. 2400 will consume less coal per ton per mile than the various types of simple consolidation locomotives now in the service, and when operated on a comparatively level line it consumed materially less coal per ton-mile. On the mountainous part of the division, the fuel consumption per ton-mile is more favorable than for the simple consolidation locomotives, but not to such a great extent as when working on the more level portions of the division.

In this mountain helper service, where the engine is kept at work for long periods between fire cleanings, it has been able to meet all rquirements, and still use ordinary run-of-mine coal, containing 20 to 40 per cent. of volatile matter.

The general condition of the boiler and machinery after 12 months of service was as follows:

Treads of tire show even wear amounting to $^{3}/_{16}$ in., or about $^{1}/_{64}$ in. per month; tires calipered uniform in diameter.

High and low-pressure cylinders were in good condition, being worn smooth and not oblong or bell-mouth.

The high-pressure piston and low-pressure side valves were in good condition. Piston valves have had the packing rings renewed once and the slide valves have received no repairs.

The engine frames, splice bolts, keys, pedestal caps, braces, etc., have given no trouble, and there have been no renewals nor repairs.

All driver bearings were in good condition, and while there have been two warm journals, due to lack of lubrication, since the locomotive has been in service, none of the frictional surfaces were injured.

The driver boxes were in good condition, crown brasses have given no evidence of becoming loose in the boxes, and are of sufficient thickness to continue in service for twelve months before renewals need be considered.

The driver wheels are fitted up when new with $^{1}/_{16}$-in. end play between each hub and box, which has been increased to from $^{3}/_{32}$ in. to ⅛ in.; the front and rear driver wheels on both high and low-pressure engines having the greater amount.

All parts of the Walschaert gear were in good condition, and the total lost motion between the main driver wheel axles and the piston and slide valves, as measured at the valve stems, with the reverse bar in full forward position, averaged $^{3}/_{64}$ in. for the low pressure and slightly less for the high-pressure engines, and for all engines in full back-up gear.

The boiler, which carries a working pressure of 235 lbs, indicated, was in good condition, and there has been no evidence of weakness or any trouble due to staying, leaky steams, leaky or broken staybolts or leaky rivets. The staybolts are of the ordinary straight type 1 in. in diameter, spaced 3¾ in., with tell-tale holes drilled at the outer end.

The firebox was in good condition, and there has been no indication of leakage, except at the furnace door ring, where two defective rivets were deplaced by countersunk head patch bolts.

The boiler tubes were good for another month's service, and there was but one flue plugged, which was due to its collapsing about eight feet from the front tube sheet.

This locomotive will remain in service until the latter part of January, 1906, when it will be removed on account of the tire wear having reached the limit allowable of ¼ in. at the tread; it will then have the driver wheel tires reset, boiler tubes removed, boiler cleaned out, boiler tubes replaced and reset, and whatever repairs that may be necessary given to the machinery and repainted. It is estimated that the cost to make these repairs and put the locomotive in condition for another year's service, or 40,000 miles' run, will be about $750 for labor and $250 for material, or a total of $1,000.

From the performance up to the present date it has been found that the following features embodied in the design of this locomotive have given entirely satifactory results, with respect to design, maintenance and operation:

The flexible joints to the high and low-pressure cylinder, receiver and exhaust pipes. Articulated frame. Intercepting, reducing and emergency valve and intermediate chamber system of compounding and simpling. Combination hand and power reversing gear. Walschaert motion gear. High-pressure piston and low-pressure double ported slide valves. High and low-pressure cylinder packing. Method of securing high-pressure cylinders to boiler. Single disc main throttle valve. Driver, crank pin and other bearings. Injectors and water works. Lubrication of valves, cylinders and bearings. Tracking and riding qualities, going forward or backward around maximum curvature, and when pushing, pulling or braking trains or running light.

There has been no trouble on account of priming, and the results accomplished through the distribution of the work over four instead of two main crank pins and auxiliary parts have been markedly satisfactory.

In consideration of the boiler having 72.2 sq. ft. of grate area, 220.0 sq. ft. of firebox heating surface, 5,380.0 sq. ft. tube heating surface, and flat and radial sheet staybolts of the ordinary solid type, the performance of the boiler, firebox, boiler tubes and stays, with 235 lbs. indicated working pressure, has demonstrated that it is economical and entirely practicable to operate well-designed and constructed locomotive types of boiler under severe weather, water, fuel and handling conditions, with from 200 to 250 lbs. boiler pressure.

While the boiler tubes are 2¼ in. in diameter and 21 ft. long, there has, with ordinary attention, been practically no difficulty on account of leaky or stopped-up boiler tubes, and the steaming has been at all times free, and such as would enable the locomotive to develop the maximum tractive power under the most severe operating conditions.

There was initially some irregular wear of the flange to the left front driver wheel tire of the forward engine, on account of the cross-equalizer of the spring gear not being sufficiently strong to carry the weight, but after a new equalizer was applied this trouble was eliminated. Several of the driver springs also broke, and the grate gear was redesigned to provide larger drop grate openings.

It also required some experimenting to make a suitable flexible connection between the oil delivery pipe and the low-pressure cylinder steam chest, which, however, has resulted satisfactorily.

While it has been noted that quite a number of changes in minor details would be desirable, should other locomotives of this type be constructed, still, when taken as a whole, the design, construction and operation in general can be considered as efficient and economical.

From a transportation standpoint, locomotive No. 2400 has been performing the service of two standard consolidation locomotives, when used as a helper, and when handling through freight trains.

This results in a saving of delay which would produce overtime in many cases, whereas the 2400 takes the place of the second helper and moves the train promptly.

In starting trains it has been frequently noticed that during unfavorable freezing weather conditions, with ice on the rails, the 2400 would push the train and take the slack between the tender and engine of the pulling locomotive, before the latter had moved its driver wheels. It has also demonstrated that it has as good a hauling capacity when backing up as when going ahead; and for the reason that it has seemingly not been stalled since in regular service, it may not be out of place to mention here that it has been nicknamed "Maud," in comparison with the renowned mule that moves anything it goes up against.

Among the advantages accruing from the use of this engine there stands prominently forth the capacity to develop a high tractive power for starting and moving heavy trains, which is at

the maximum because the whole of the 334,500 lbs. of weight are distributed over the 12 drivers. This involves a tonnage and speed per train that will provide for the least number of locomotives and crews. The result then of this year's service indicates that for slow freight service, where a greater tractive power is desired than what can be obtained from a properly designed consolidation type locomotive, is that it would appear that the use of the Mallet articulated design, as already described, would result in the movement of the greatest tonnage per hour over a single piece of level or mountainous track, with a proper degree of safety, efficiency and economy.

NEW YORK RAILROAD CLUB DISCUSSION.

At the conclusion of the reading of his paper, Mr. Muhlfeld added a few words in which he emphasized his belief that the steam locomotive was by far the most desirable, flexible and economical for the handling of heavy traffic. In short, he definitely threw down the gauntlet to the advocates of the electric machine.

The discussion which followed totally ignored the desirability or the practical operation of heavy locomotives in themselves, but swung around the relative merits of the two types as set forth in the paper. It naturally followed that there were differences of opinion as to the details of opinions expressed, though no position taken by the writer was seriously attacked. The first speaker, Mr. Gaines, for example, doubted the advisability of using high steam pressures. He said that while it was perfectly possible to build boilers that could carry a 250-lb. steam pressure, experience had shown that these high loads tended to a rapid deterioration of the boiler, and that as a matter of fact the life of the firebox was about in an inverse proportion to the pressure it was called upon to carry. A further peculiarity of this is also to be found in the fact, that while, with the lower pressures the deterioration of the firebox is gradual, when the higher is used the box simply goes all at once.

The reply to this argument was that while there had been some trouble with leaky tubes, due to the wide variations of duty that the boiler had been called upon to perform, and to the carelessness of the fireman in running with dirty fires or fires with holes burned through, they had been comparatively insignificant, and when the engine was brought into the shop but two broken staybolts had been found.

Attention was also called to the use of inclined planes of the Central Railroad of New Jersey for handling the heavy coal traffic up to the summit of the divide between the Wyoming and Delaware valleys as presenting a possible comparison in cost of operation with that of electric locomotives that require a special power plant for their propulsion.

Evidently the steam locomotive, especially the Mallet compound, was in the hands of its friends, for there seemed to be no word of adverse criticism in regard to it. It appears that it is an exceedingly easy riding engine, and that it is no more effort to handle it than it is the ordinary engines of the road. There has been no complaint on the part of the fireman as to the amount of labor involved in the shoveling of the coal, and the maintenance of the steam pressure. This may possibly be due, as one speaker expressed it, to the fact that it was designed on easy lines. That is to say, there was a liberal allowance for all of the parts that enter into its construction, and advantage was not taken of every possibility to save in weight and space. As for its development of power, it was estimated that, at 4½ miles per hour, it developed about 860 horse-power, which was increased to about 1,860 when the speed rose to 10 miles per hour. The general average of the power that was used was placed at about 1,500 horse-power. As for the work of the engineman, he seemed to have less trouble with the reverse lever; that is to say, it took less exertion to move it than with the ordinary consolidation locomotive.

It was generally agreed, however, that the matter of the cost of repairs of this engine had not yet been definitely or finally settled. The engine was new and the cost of the first year must necessarily be less than those of the years to come, and it is expected that the rate that has prevailed up to this time will be increased from year to year, for six or seven years, after which it will settle down to an average that will be maintained through the balance of the life of the engine. Attention was called to the fact that the repair cost of different engines varies almost in direct proportion to their first cost, or, to express it differently, in proportion to their tractive power. This is merely another way of saying that it varies as the weight of the engine.

In Mr. Muhlfeld's paper comparisons were made of the cost of operating steam and electric locomotives that were in favor of the former. These were criticised on the ground that the electric plant and locomotives of the Baltimore & Ohio had been designed ten or twelve years ago, and that they were obsolete and old-fashioned, so that it could not be expected that they would be fully up to modern, present-day requirements and able to make the showing that was obtained with a locomotive of the latest design. The reply to this was that, as a matter of fact, the older electric locomotives of the Baltimore & Ohio were doing better service and doing it more economically than the new ones, and that the Mallet engine must be considered in the light of an experimental machine as well. As for the power plant, it was acknowledged that it was somewhat out of date, but still it was claimed that it was working with good economy, and though it was the intention to rebuild it, the company was well satisfied with its present performances. It provided power for the shops where about one hundred motors were at work, besides charging the storage batteries, so that, in spite of the fact that the requirements of the road service were apt to vary, the load on the power house was practically constant.

It seemed to be a curious coincidence that the specifications for an electric locomotive as laid down by Mr. Muhlfeld, comprising fourteen points (omitted from our report of the paper), were almost all covered in the latest type of electric locomotive. It was urged also that it is possible to combine more power in an electric locomotive under the control of a single man than would be possible with any steam engine. The use of several units that could be combined and worked as a single machine offered advantages that no ordinary locomotive possessed. It was claimed and conceded that the accelerating power of the electric machine far exceeded that of the steam, and the case of the New York Central engine was cited as an instance.

A discussion had arisen on the point that developed a kind of sporting proposition, in which it was suggested that the two types of engines be placed alongside and with the same weights of trains, race from a standing start for the length of the electric line at Schenectady. This was done, a Prairie type of engine with about the same weight on the drivers being used as the competitor. In spite of every effort, the electric locomotive won in each of the four trials that were made, by about a quarter of a mile. During the acceleration the engine developed about 2,500 horse-power at the wheels. This was made possible because the present control of three engines is such that the drawbar pull is maintained constant during the whole period of acceleration.

The Mallet and other steam locomotives had been criticised because they had been able to develop but 10 horse-power per ton of weight, though it was claimed to be possible to exceed this. The New York Central engine had developed 22 horse-power per ton under normal workings, while as much as 30 horse-power had been obtained at times.

One other advantage of the electric locomotive is that it is in perfect relative balance, which is not the case with the steam engine. It is in the details of the electric engine that improvements must be made. As one speaker expressed it, the paper of the evening seemed to be a plea for the further development of the electric locomotive.

Motor cars were kept pretty well out of the discussion, though they were alluded to, and it was urged that, as they had been worked up to a state of practical perfection and the cost of maintainance had been reduced to a minimum, it was fair to use these figures as the basis for estimating the value of the electric locomotive along the same lines. This was not conceded, however, as the conditions of operation were so different and the requirements of the service of the latter so severe that it was claimed that comparisons along these lines were impossible. One item of the details of these cars was mentioned that is of interest. The gearing between the armature shaft and the axles has been found to be wanting. Starting with the rawhide pinion and steel gear, the railroads had then taken up the cast-steel gears and now, with the heavy motors that are used, these had been found to be too weak. There is a shearing stress on the teeth that they cannot withstand, and it has been found to be impossible to secure castings of sufficient strength and homogeneity to stand up to the work. It has therefore been found to be necessary to resort to forged ring gears in which the teeth are cut in a forged ring like the tire of a wheel.

As between the direct and alternating current machines, there seemed to be a tendency to favor the latter, though the greater part of the discussion referred directly to the former. The advantage claimed for the latter was that the motors could always be used in parallel so that there was less danger of slipping than in the case of the direct current machine; in fact, this slipping of one pair of drivers was one of the principal drawbacks that was acknowledged to exist in the present electric locomotive.

In closing the discussion, Mr. Muhlfeld emphasized his earlier statement that the boiler of the Mallet engine had given no trouble at all, and that the occurrence of leaky tubes had been insignificant, in spite of the high pressures and the fact that these tubes are 21 ft. long, the longest that have ever been applied to any locomotive in this country. He felt that the electric locomotive was laboring under the difficulty of lying between the use of the overhead trolley and the third rail. The overhead trolley was impractical with the direct current, while the disadvantages of the third rail were to be found in the increased first cost, increased complexity of mechanism, the increased danger of personal injury to workmen and others and the fact that it is not adapted to working with voltages greater than 600. It was suggested that the single-phase alternating engine with the mechanical details worked out along the lines that had been

followed on the Valtellina road in Italy offered a solution that should be carefully considered.

The claims that the electric locomotive had won out where it had been placed in competition with the steam engine was met with a contradiction and a counter-claim that it had been introduced where the conditions of the traffic were such that the steam engine could not be used. The case of the Baltimore tunnel is in point, and the same holds true of the work that is now being done in New York. It is simply a question of the inability of the steam engine to meet the requirements, and has no relation to its tractive capacity.

In reviewing the discussion as a whole, it appears that the consensus of opinion was that electric locomotives, like those that are driven by steam, must be designed for the special service that they are intended to perform, and that no one type can be taken as universally applicable, while in the matter of heavy freight service the time does not seem to have yet come when it can compete in economy of operation and maintainance with the steam machine.

Horseback Inspection of the Philippine Railroad Projects.

BY L. E. BENNETT.*

On May 19, 1905, I started from Iloilo, the seaport of the Island of Panay, on an inspection of the railroad projects for which bids had been asked by the Government. The first route to be covered was the proposed line from Iloilo north through Pototan, Passi, Dumarao, and Dao to Capiz, 78 miles, with a branch line 22 miles long to Batan in northern Panay, which is a flourishing port on the coast. Our party consisted of a native cook, who also acted as interpreter, one native soldier and myself. Food, bedding, cooking utensils, dishes and other supplies were carried on a pack pony and each of the party was mounted on another native pony. With this outfit we could make about 20 miles a day over the trails, sleeping at night in the most convenient settlement along the way, usually as the guests of some native village official.

Escort of Native Soldiers.

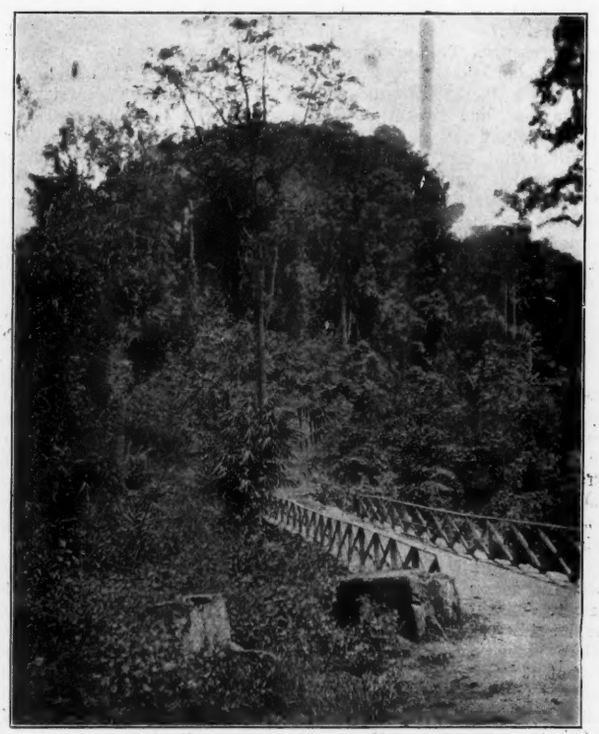
Cocoanut Rafts on the Pagsanjan River.

From Iloilo to Passi the proposed line passes through a country much like that to be seen in eastern Nebraska, ranging from absolutely flat to low undulating hills. Everywhere, of course, is heavy tropical vegetation. The route is through an almost continuous line of small villages from Iloilo out to Pototan, 20 miles. The public highway is lined with houses for the entire distance. Long lines of pedestrians can be seen on the highway from dawn to dark carrying packs of farm produce on their backs into the larger towns. These native farmers will carry from 50 to 75 lbs. of farm produce, fruits and even grass and forage on their backs in this manner and trot along the dusty roads for miles to sell their load and return with the equivalent in the necessities of life which they cannot get from the soil. Carts and farm animals are scarce and during the rainy season the roads become so muddy and at times are completely flooded so that they are impassable even for men on foot to say nothing of carts. Under these circumstances it is not to be wondered at that there is little prosperity and progress.

The population reached by this first 20 miles of the line must exceed 350 per square mile, or about six times the average rural population in the United States. For the remaining distance up to Passi, 35 miles from Iloilo, the population is over 200 per square mile. The country beyond Pototan is more undulating but easy building for a railroad with light grades and curves. It would involve comparatively light construction work with the exception of the numerous bridges and flood openings.

I carried a letter of introduction from the Governor of the Islands to all native officials in the towns which secured for us every attention and assistance. The Filipinos are naturally a hospitable people and will almost always share what they have with a traveler and decline to accept payment for food or lodging. After a two-days' journey we arrived at Passi on Saturday night, and having been invited by the Presidente, or local mayor, to spend Sunday as his guests, we accepted. He welcomed us heartily when he learned my mission.

Passi is a large town with several thousand inhabitants, located in the center of an extremely fertile district. In the surrounding lowlands rice and sugar cane are grown, and in the hills hemp, coffee, cocoa, grass fibers for making fine grass cloth, and a fair quality of tobacco are grown. Only a small part of the land is under cultivation as it costs at present from $30 to $40 a ton to carry the produce down to the



Country Road in the Philippines.

*Mr. Bennett, who has been actively engaged in pioneer railroad surveys and construction, in many parts of the world, was employed by J. G. White & Co., who intended to submit bids for the construction of a number of railroad lines in the Philippine Islands, which were authorized by the United States Government, to make a reconnoissance of the country through which it was propesed to build. Early in 1905 he began his trip through the Islands and on his return to the United States made a favorable report which served as a basis for compiling the bids made by J. G. White & Co. These bids for an aggregate of nearly 300 miles, have been accepted by the Government. Some of Mr. Bennett's experiences are told by him in this interesting extract from his diary.

Rice Fields Near Iloilo, Panay.

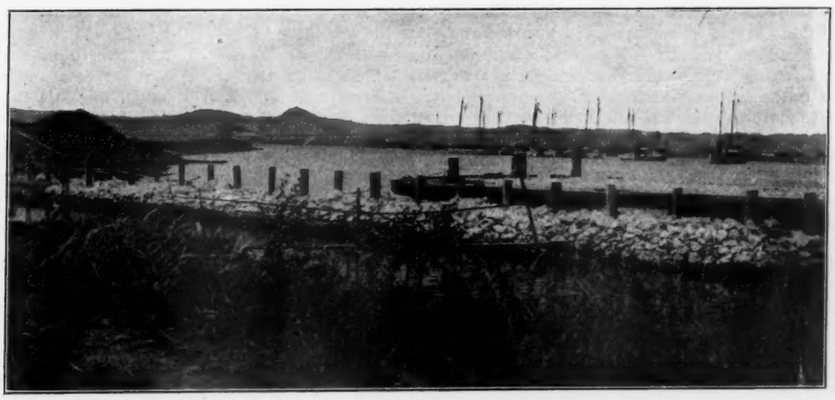
market at Iloilo, and only during the dry season can anything be transported. The opening of a railroad through this country will develop it rapidly as thousands of families are only awaiting transportation facilities to move in and cultivate the rich soil.

On Sunday afternoon the Presidente took us to see the cock-fights in the municipal cock-pit. Cock-fighting is the national sport of the natives, and men, women and children attend the Sunday mains which are the event of the week. Early Monday morning we started on the next stage of the journey to Dumerao.

Between Passi and Dumerao a range of low hills forms a divide about 300 ft. high and 11 miles across. This divide is sparsely settled but presents no great engineering difficulties in the way of railroad building. The north side of the divide slopes down gradually into a beautiful and fertile valley which extends to the coast and the port of Capiz. The principal town between Passi and Capiz is Dao, which stands at the junction of two small rivers in the midst of the rich rice fields. Dao shows evidences of great loss by the war. The remains of many wood and masonry houses indicate that it was a flourishing settlement before the war broke out. Dao is 19 miles inland from Capiz and the country lying between is rich and under extensive cultivation. A succession of small villages extend all the way down to Capiz, which is a substantial and flourishing sea port doing a large business and having good stores, large warehouses and a number of comfortable residences.

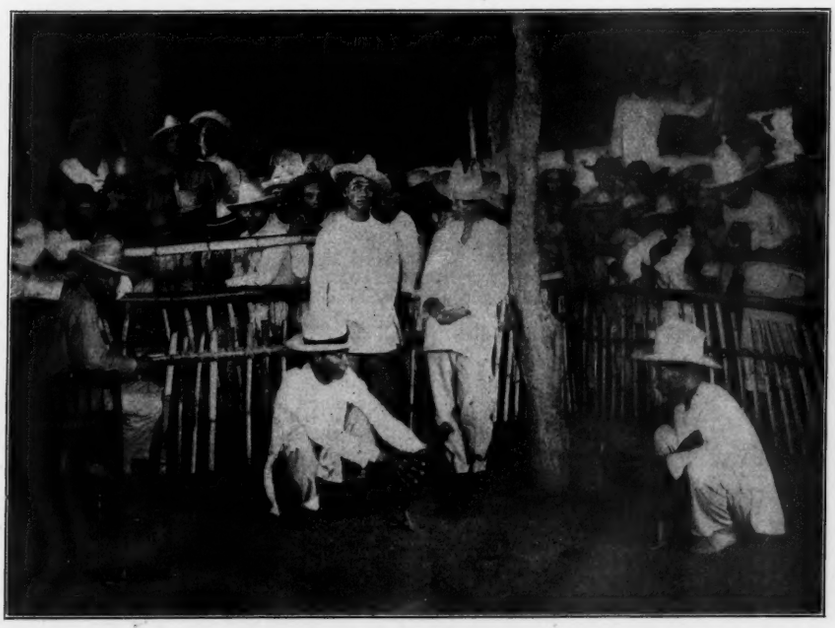
Arriving Capiz I found that a coasting steamer was leaving next day for Iloilo, and thinking that the return trip would be made quicker and with more comfort by boat, the ponies and pack outfit were sent back empty to Iloilo over the trail we had followed. The boat, a small coasting steamer of 100 tons register and called the "General Blanco," did a general trading business along the coast, dealing chiefly in fish of various stages of decomposition. In all my travels I have never encountered such a vile odor as we were compelled to endure for the next two days, not even excepting a steamer loaded with garlic on which I made a trip from Alexandria to Brindisi. Fish never seem too badly decomposed for human consumption in the Orient. When we arrived at Iloilo I was compelled to throw away what few clothes I had taken with me as the smell had permeated everything.

Another interesting inspection trip was through the island of Negros over the route of the proposed railroad. I left Iloilo in a steam launch on July 12, 1905, making for Himamaylan on the southwestern coast of Negroes. It was a beautiful trip down the narrow strait between Panay and Negros and we landed in the evening at the town which is at the mouth of the tidal estuary called the Himamaylan river. This estuary is used in a small way as a port for shipping sugar.



River at the Port of Iloilo, the Terminus of the Railroad.

We slept over night at the house of a half-breed Spanish planter who was the son of a Spanish priest and a native woman. His father had long been the virtual ruler of the town before the war. The next day the planter provided us with horses and a two-wheeled cart and accompanied us as far inland as San Juan de Ilog. The whole country between Himamaylan and San Juan de Ilog is practically one continuous sugar plantation, the soil being a rich alluvial loam. The plantations have many substantial buildings on them and in many ways this is the most prosperous looking district in the islands. The land holdings on Negros are nearly all in large tracts of 200 to 2,000 acres. On the other islands the holdings are smaller, most of the farms being about two acres, which supports an entire family.



The National Sport of the Filipinos.

On the second day we started from San Juan de Ilog to visit a large volcano about 7,000 ft. high situated some distance inland. We went on horseback as far as Isabela, passing through a rich country planted with sugar cane and corn. The mayor of the town supplied us with chickens, eggs and rice and with the supplies of canned milk, butter and other necessities not to be had in the interior towns but which we carried with us, we prepared a plentiful noon meal. After lunch the mayor, dressed in immaculate white, accompanied me to a small hill back of the town where we could overlook the valley and get some photographs of the village and the surrounding sugar plantations. He had a great contempt for his countrymen who labored and soiled their hands and he would not think of appearing in public unless neatly dressed. His young nephew

whom I met before we left, told me he had been attending college at Iloilo and had been studying theology and philosophy. His father had borrowed the money to send him by giving his farm as security and paying a high rate of interest. They had very little to eat in the house but the young Filipino was very much disgusted when I suggested that he would have made better use of his time by studying improved methods of cultivating sugar and rice. Unfortunately this is too frequently the effect of a little education on the average young Filipino. It only gives him the idea that it is dishonorable and degrading to labor with his hands.

Leaving Isabela early in the afternoon we arrived that night at the foot of the volcano where we spent the night with an unusually intelligent native lieutenant of the Constabulary in command of a detail stationed there to catch some cattle thieves who had been operating in the neighborhood. He had been to the St. Louis Exposition and had just returned from the United States. When I told him about the young student of Isabela he laughed and his comment was that many foolish young Filipino students preferred philosophy and an empty stomach to the study of sugar cane culture with plenty to eat.

The next morning he accompanied our party to several sugar plantations and from a small hill near one of them a planter showed me the whole surrounding valley which was a magnificent sight. We could see about 20,000 acres of rich sugar land still uncultivated for want of good roads and transportation facilities. The gently sloping sides of the nearby volcano showed another 20,000 acres suitable for growing coffee, cocoa, rubber, gutta percha and manila hemp. One enterprising native planter had started a plantation on the volcano slope and had demonstrated that it was possible to cultivate all of these products successfully, but he was unable to make the venture pay for want of communication with the markets.

Leaving this valley we crossed a low range of foothills about five miles across which were uncultivated and sparsely inhabited. On the other side was another valley of sugar plantations and for seven hours we passed through a continuous line of plantations, arriving at La Carlota about 10 o'clock in a drenching rain. We tried to get a night's lodging at the house of the Mayor but he and his chief-of-police had gone out to spend the night with some planters and to have a game of "monte." A frightened policeman whom we encountered finally took us to the house of an American school-teacher who put us up for the night.

The next day being Sunday we rested and in the evening our pedagogue host took us to the Planters' Club, where we met some of the leading native planters. The club house was well furnished and they kept on tap several of the best-known brands of American and Scotch whiskey. The members played poker and several of them could swear fluently in English, demonstrating in various ways that the village of La Carlota is fast attaining a high state of civilization.

Early Monday morning we started on our way to Murcia, where we arrived at night, having passed through extensive and fertile sugar plantations, corn fields and much wild land uncultivated for want of roads. From Murcia we went down to the sea to the port of Silay. Here we spent the night very comfortably at the residence of Senor Domingo Hernaiz, a rich native planter. On the following day our host accompanied us about 20 miles on our journey along the coast to Manapla. This is a town which does a considerable business in native timber, the logs being floated downstream with bamboo floats from the forests several miles back in the interior. These forests extend inland to the summit of the volcano and there are thousands of acres of rich timber land awaiting the coming of the railroad to be opened up. It will pay well to build logging lines from the main line into the forest.

From Manapla we continued on to Cadiz the next day where we were entertained by the Mayor and the American school teacher. An impromptu dance was arranged for us which was not altogether enjoyed after a long day's ride on horseback. The teacher told me of having established a young ladies school for teaching improved methods of cultivating the soil but at first his pupils, who belonged to the leading families, brought servants along with them to the gardens to do the work. When they finally were made to understand that they, and not the servants were to be taught, they willingly undertook to do the work and were then making good progress.

Leaving Cadiz in the morning we arrived at night at Escalante, the port of Danao, at the mouth of the Danao river. This river is 700 ft. wide and 50 ft. deep and affords good anchorage for eight or ten steamships. There is a bar at the mouth of the river which must be dredged out first, however. We lodged with constabulary officers and were well received by the natives. After resting a day we telegraphed for a steam launch to meet us at Victoria on the northern end of Negros to take us across the rough channel to Panay and then back to Iloilo. We took passage on a sailing lighter to Victoria, traveling as guests of the owner, a Chinese merchant who traded along the coast. Head winds and the strong tide delayed us and just when we were within sight of Victoria, the steam launch sent over for us turned and steamed back to Iloilo, having waited in vain for our coming. One of two things was left for us to do, return to Silay on horseback or risk crossing the rough channel in a small fisherman's boat. The wind was blowing hard and the waves were high but we decided to risk the small boat and in two hours time had navigated the 20 miles across the channel. The little boat was only 30 ft. long, but the fishermen were good sailors and guided us skilfully and safely. A few hours later we were in the harbor of Iloilo.

The Island of Negros is capable of producing 400,000 tons of sugar a year when cultivated and developed with modern appliances and provided with transportation facilities. The country is well drained and slopes gradually toward the sea on all sides from the volcano in the center of the island. The soil is volcanic ash and mud thrown out by the eruptions of past ages, and there is no better soil anywhere for the cultivation of sugar cane. Railroad construction will be easy with light grades and curves. The cost of railroad building should not exceed $30,000 a mile, and the road should pay good returns on the investment as the country develops. The railroad will cause a vast acreage to be brought under cultivation which is now wild land.

Senator Lodge on Rate Regulation.

The following highly condensed abstract is taken from the speech on rate regulation delivered by Senator Lodge in the United States Senate, February 12:

The evils complained of in our system of owning and operating railroads may be practically covered under three grievances:

1. Discrimination between persons.
2. Excessive rates.
3. Discrimination between localities.

Mr. Lodge argued that the discriminations known in this country as rebates and in England as "undue preferences" form a large proportion of all the injustices complained of, and nothing is more important than to cure them. "In nine cases out of ten," he said, "where I have talked with any one who was very eager for general railroad legislation and especially for Government rate making, I have found that the special grievance complained of was a personal and not a place discrimination." Arguments for or against Government interference to stop rebates have no application to the questions of excessive rates or of discriminations between localities. We have a stringent law recently passed against rebates. Government rate making is not, and cannot furnish, any remedy by and of itself for personal discrimniations or rebates.

"The evasion of the established rate for the benefit of a favored shipper, which constitutes a discrimination between persons, therefore, must be dealt with not by general legislation as to rates, but by an ample provision for punishing those who violate the law. I regard these discriminations between persons, or rebates, as by far the greatest evil now existent in connection with our railroad systems and as one of the most fruitful in wrong and injustice with which we have to deal. It is upon these personal discriminations that the great trusts whose operations have not only alarmed the people but have made them justly indignant have been built up. To make the law thoroughly efficient we ought to add, in my judgment, three provisions. We should restore the former penalties of the interstate commerce law—which should not have been repealed—and make these secret evasions of the published rates punishable by imprisonment. The men who perpetrate these evasions in defiance of the law suffer but little by a fine, even if it be a heavy one. Their resources are too large to make a money penalty a serious one. For this very reason they are persons who would feel acutely a punishment by imprisonment, and that penalty ought to be provided in any law which we pass.

"A second addition to the present law which we need is a provision to facilitate the procuring of evidence by the law officers of the Government. This defect has been pointed out by the Attorney-General in his report, and I think nothing is more requisite than a clause enabling the proper authorities to examine the books of the railroad companies whenever they have good reason to think rebates are being granted. A third and last addition should be the enactment of suitable provisions in regard to private car lines, switching charges, private sidings and tracks, elevator charges, midnight rates and all the various and ingenious arrangements now employed to cover up the grant of rebates. That the eradication of rebates is not impossible, or in the least impracticable, is proved by the experience of England, where 'undue preferences' are practically unknown and where the railroads are most reliable in the payment of dividends, showing that the abolition of rebates and personal discriminations would be to the railroads a solid benefit instead of a fancied injury.

"It may, I think, be safely asserted that if there was no grievance to be dealt with except excessive rates there would be no need of any legislation whatever. We could safely leave the cure of excessive rates to the law of competition among the railroads themselves, and where there were no competing lines to the competition

of markets, which no consolidation nor combination of roads can do away with."

With regard to England, Mr. Lodge quoted Mr. Acworth's testimony, as follows:

As to rate making, I have no doubt that the interference of Parliament and courts and the executive has all tended to stereotype and keep rates at an unnecessarily high level. Speaking as an individual student, I have no doubt that leaving the power to make rates generally and primarily to the railroads and to the free play of the business forces is the process that will arrive at the best results for the community, with this exception: that I fully think it is necessary that the community in some way should interfere to protect all customers from unfair treatment.

"In England the result, practically, of the very moderate legislation which they have adopted has been to make the rates almost wholly inelastic. No railroad dares to lower a rate, if it can possibly be avoided, because of the restrictions imposed by law on increasing the rate when it becomes necessary. The result is that rates in England have not, as a rule, declined; and while our rates show a decline of 41.7 per cent. as against a 24.3 per cent. fall in prices, it is apparent that in England prices have fallen faster than rates, owing to the fixed character given to rates by legislation.

"To sum what we may learn from the English experience, we find that the provision against increasing rates has prevented the reduction of rates, that undue preferences or rebates have been successfully stopped, that discriminations between localities exist and that the long and short haul discriminations are not interfered with. It therefore appears that in England the rate making by Government, so far as it has gone and so far as it affects discriminations between localities, has had either no result or has prevented rate reductions."

In France, with nearly all the railroads in private hands, but governmental regulation of rates very stringent, amounting practically to Government rate making, the result has been "to make rates inelastic, to keep them high and to drive business to the waterways. Discriminations between localities exist just as they do here, but are made by the Government in obedience to local financial and political influences, which exert power in proportion to the pressure they can severally bring to bear."

In Germany, where almost all the roads are operated by the Government, and with a complicated system of rate fixing, Mr. Lodge demonstrated that instead of doing away with discriminations Government rate making has resulted in giving discriminations of one sort or another to 80 per cent. of all the freight carried. Rate fixing there "has been carried out with an elaboration and scientific thoroughness unequaled anywhere else. The result has been the abolition, practically of rebates or personal discriminations, and the multiplication of all other discriminations, extending not only to localities, but to industries, character of articles, and the final destination of the freight. The outcome of this system of discrimination has been to sectionalize Germany and to draw tariff barriers around certain regions or districts, and the discriminations have been brought about by the pressure of political, local and industrial interests, have been taken up by political parties, and have played a large part in national politics and in the legislation of the Reichstag. It is also apparent that, although Germany has managed to make a profit on her railroads, the transportation efficiency is low, the railroads are run with great disregard of public convenience and rates are 50 per cent. higher than our own and are inelastic."

Mr. Lodge called attention to substantially the same state of affairs in Austro-Hungary, Italy and the smaller European States. In Russia, where rates are fixed by the Government and are lower than anywhere else except in the United States, the roads are run at a loss, which the taxpayers have to make up. Government rate fixing, apart from the deficit it occasions, has impeded the freight movement in Russia, by oscillating one way and another under pressure of local interests, has sent freight to the waterways and has not removed discriminations, but merely substituted others.

"If now we review the experience of all other countries, taken as a whole, we find a singular uniformity of result so far as general principles are concerned. This examination shows us that it is not only entirely possible to abolish all discriminations between persons—that is, all rebates or undue preferences—but that this has been actually and effectively accomplished in other countries. It is not necessary to differentiate between the methods employed in the several countries, for whether, as, in England, railroad regulation has been effected through the establishment of a railway commission court, or, as in France and Germany, by the simple operation of direct Government control, the conclusion on this point is the same. It is proved beyond a doubt that personal discriminations can be utterly extirpated, and if it has been done in other countries it can be done here by suitable legislation.

"On the second point of excessive rates the experience of other countries demonstrates that whatever good effects Government rate making has had it has not lowered rates, but, on the contrary, has made them not only higher but inelastic. Where, as in Russia, rates are low, although not so low as ours, the railroads are run at a loss, and the loss is made good out of the pockets of the taxpayers. In England, with maximum rates fixed by Parliament in a schedule and the prohibition against raising rates without the consent of the railway commission court, the rates are higher than ours, inelastic, and do not decline in accordance with the fall of prices, or, indeed, in any substantial degree.

"On the Continent of Europe generally rates are 50 per cent. higher than ours and show the same quality of inflexibility and the same lack of adaptation to changing conditions which we find in England. We have the lowest average freight rates in the world, and yet our railroads are run at a profit without, of course, a dollar of expense to the taxpayer. Government rate making in this country—directed as it can only be against place discriminations and excessive rates—therefore, if the experience of all the rest of the world is of any value, and I regard it as conclusive, would either not reduce the rates at all, or, if it did reduce the rates generally, it would destroy the profits of the roads and lower the wages of those employed upon them unless we accepted the other alternative of Government ownership, with the roads run at a loss and the people taxed to carry them on. The idea of many persons who have been urging Government rate making in this country appears to be that Government rate making will lower freight rates. In seeking popular support that is one of the inducements they hold out, and yet it is as clear as anything can possibly be that it will be impossible to reduce rates arbitrarily and suddenly by Government action without destroying the profits of the railroads and lowering the wages of those employed upon them, or else forcing government ownership and placing upon the shoulders of the taxpayers the gigantic burden of running 200,000 miles of railroad at a loss. So far as excessive rates alone are concerned, it seems to me perfectly obvious from the experience of other countries that there should be no legislation, because if legislation is attempted the results will be disastrous in ultimately raising rates and in making them inflexible and will produce a far worse condition than now exists under the play of natural forces.

"The third and last point is that of discrimination between localities. The experience of other nations shows that government rate making has not stopped discriminations in the slightest degree. It has substituted discriminations made by the government for the discriminations which are brought about by economic forces, the competition of markets and the action of business interests. It hardly, I think, needs argument to show that discriminations forced in this way through political action would be peculiarly unfortunate in the United States, and that the combinations of political interests would make discriminations which would be in the long run more oppressive than those which come into existence by the natural competition of business interests and the working of economic forces. That discriminations which arise in what may be called the 'natural' way have in some instances been created to serve the selfish ends of individuals intrusted with the management of railroads is undoubted, but the history of our railroad development shows that these are constantly being reduced in number, and that the laws of competition and the necessity of earning money are certain to cure them in the long run. Moreover, the discriminations which exist in what may be called the 'natural' way have the immense advantage of not leading to those results so apparent in Germany, where the pressure of local and political interests has forced the establishment of rates which have broken the country up into sections and thrown around each section a barrier higher than those which any tariff could create in obedience to the entirely false principle that any given town or city or any given area of country is entitled by its neighborhood to the sole possession of the region and the population immediately surrounding it.

"That discriminations between localities exist under our system which work injustice it would be folly to deny, but it would be a still greater folly to establish a new series of discriminations, working a larger injustice in the hope of curing the original inequalities. To get rid of the inequalities which exist is eminently desirable; but it is much better to submit to those than to create more and worse inequalities by another system which experience has proved to be worse. In this direction, therefore, it seems to me that we ought to proceed with the utmost caution. Whatever attempt to remedy place discriminations we may make we should so guard it as to avoid applying a remedy far worse than the disease. The experience of the world leads me to doubt most seriously whether any government rate making, with a view to curing place discriminations, can be affected without bringing a change for the worse; but if it is to be tried at all it ought not to go beyond the fixing of a maximum rate by the commission, with the most absolute protection against hasty or prejudiced action through provision for an appeal to the courts of the country. This certainly is as far as we can safely go, unless we are prepared to disregard entirely all the teachings of experience and all the wisdom of those who are authorities upon railroad economics.

"In closing this consideration of the lessons of experience in regard to the relation of the railroads to the Government I wish again to insist upon the magnitude of the problem. I am looking at the railroad system simply as one of the greatest forces in our

modern economic life, upon which the prosperity of the country and its trade and commerce are more dependent than upon any other. It is in this way and with this spirit that Congress should approach the discussion of this question. Many of those who are loudest in denunciation of the railroads, and who assume to speak for the people of the United States, confuse their own personal hostilities, and, in some cases, their own desire for revenge, with the public interest, which has no grudges to satisfy and which seeks only to promote the general welfare. Even the shippers who especially cry out for sympathy, it is well to remember, have shared, in some instances at least, in the rebates and personal discriminations which could not have existed without their seeking and collusion, and mistake occasionally the disappointment caused by a failure to secure preferences themselves for a righteous indignation which aims solely to redress a public wrong.

"It must be remembered that the idea so sedulously disseminated that the railroads are merely the property of a few men and run for their selfish interests, is without foundation in fact. The vast capital invested in railroads and distributed in the form of stocks and bonds is held by thousands of persons, many of whom have most moderate means. These securities largely constitute the securities of savings banks, in which are laid up the hard won earnings of the working men and women of the country, and if we injure or destroy these securities we only affect slightly the great capitalists, but we bring misery and misfortune and poverty to thousands of persons whose little all, either in their own names or that of the savings banks and the trust companies, has been placed in the railroads of the country. It is well also not to forget that the high paid men who are at the head of the great lines of road are but a handful in comparison with the great body of people who earn a secure but modest livelihood in the operation of railroads. There are between two million and a half and three million of people whose livelihood is dependent upon railroads. To force by ill considered legislation a reduction in the earnings of this great body of people would be a cruel injustice, but that is just what we shall do if we do not consider well the steps we take.

"I consider it essential that we should have proper legislation in regard to the railroads, that there should be Government supervision and regulation, that we should stop the intolerable abuse of rebates or discriminations between persons, because if we do not we may find ourselves precipitated into that worst of all disasters, government ownership. But it is equally essential that the legislation we undertake should not itself lead to government ownership, the dangerous pitfall we are seeking to avoid. It is vital that this legislation should succeed, but it can only succeed by being effective against the evils which it can cure, while it proceeds with the utmost care in those directions where experience has shown that some of the remedies now proposed have introduced evils far more unbearable and far more injurious than those which it was sought to remedy.

"Two dangers seem to me to menace that legislation. The first is that in the desire to have rates fixed in some form by an executive commission, exercising powers delegated to it by Congress, we shall fail to give an effective remedy for the worst evil which has arisen, that known as 'personal discriminations.' Whatever else governmental rate making can do it cannot by the mere fact of its existence do away with an offense which consists in the evasion of an established rate. A result of a failure to deal with what, to my mind, is the real, and, I am strongly inclined to believe, the only real evil of the present conditions would be to discredit the law, convince the people that it was insincere and thus promote an agitation in favor of that worst of all evils, government ownership. Whatever else is done or left undone, no pains should be spared to render the law effective for the absolute extirpation of personal discriminations or rebates. That which is to be feared as to rebates is that the law will not go far enough and will not be intelligently effective.

"The second danger which is involved in this legislation is that the rate making by the Government, which can only affect excessive rates and place discriminations, will go too far and will bring on evils far more serious than those it is designed to cure. The lessons to be learned from the experience of other nations confirm this view and admonish us to proceed in this direction with the utmost caution. We should not go too far in rate making by Government—surely not beyond conferring the power upon an executive commission to make maximum rates. The commission charged with this great duty, upon the just performance of which the stability of business and of credit, as well as the welfare of thousands of people will so largely depend, should be established and organized with the utmost care. In tenure and salary the office of Commissioner should be made acceptable to men of the highest character and ability, and the chairman of the commission should, as in England, be taken from among the judges of our circuit courts.

"Finally, there should be ample provision for an appeal to—or, more properly, a review by—courts of competent jurisdiction sitting in equity, not only as to whether the rate is confiscatory, but also whether it is just and reasonable, and an arrangement should be made by law for the rapid disposition of all such cases.

"There seems to be now prophets of a new dispensation who wish to depart from the line marked out by the President in his message and accepted in the House bill of last year by removing so far as possible from the proposed law all proper provisions for review by the courts. This seems to me to strike at the very heart of the measure. I am anxious to see this legislation, but I cannot assent to any restriction upon the right of an American citizen to seek redress in the courts of the country. I am not yet prepared to substitute for the courts of the United States an executive commission. A proper solution of this railroad question is of vast importance, but it sinks into nothing compared with the primary duty of preserving to every American—high or low, rich or poor—free access to the courts of the country. I am quite aware that no statute can take away the constitutional right of a citizen to appeal to the courts if an attempt is made to take his property without due process of law. In other words, legislation cannot prevent an appeal to the courts if it is alleged that the rate is confiscatory; but this is a very narrow ground and a very limited right.

"A rate may not be absolutely confiscatory and yet may be in the highest degree unjust and unreasonable, and indeed well-nigh ruinous. I am not sure that it would be possible to deprive a citizen by legislation of the right to appeal to the courts as to the justice and reasonableness of a given rate, which is a purely judicial question. But no attempt ought to be made, either directly or indirectly, by silence or by assertion, to destroy this privilege, or, rather, this right. If delays are feared it is easy to make arrangements by law which will compel the swift disposition of these railroad cases. If it is a question as to maintaining a rate pending an appeal, either by bonds or by paying the money into court, loss to the party successful in the suit can be prevented. None of these objections have any real weight. But the distrust of the courts, the inclination to refuse an explicit statement of the right to such a judicial review of the commission's decision as are now manifested are ominous in the extreme. Nothing could be more alarming to reflecting men than the dispositions shown by some persons to transfer to the legislative and executive branches powers pertaining to the judiciary and thereby deprive the citizen of the most fundamental and sacred of rights.

"We are about to pass a great measure from which, I hope, great good may come, but one which, in its operation, will affect the property and interests of millions of our fellow citizens. It should be guarded with scrupulous care, but above all it should provide that no man should be deprived of his opportunity to go to the courts in defence of his rights if he thinks those rights are invaded."

The Panama Canal.

The report of the Board of Consulting Engineers on the Panama Canal, together with the report of the Isthmian Canal Commission and letters by Secretary Taft and Chief Engineer Stevens, were submitted to Congress on Feb. 19 by President Roosevelt, who added the following letter of his own, advocating a lock canal.

To the Senate and House of Representatives: I submit herewith the letter of the Secretary of War, transmitting the report of the Board of Consulting Engineers on the Panama Canal, and the report of the Isthmian Canal Commission thereon, together with a letter written to the chairman of the Isthmian Canal Commission by Chief Engineer Stevens. Both the Board of Consulting Engineers and the Canal Commission divide in their report. The majority of the Board of Consulting Engineers, eight in number including the five foreign engineers, favor a sea-level canal; and one member of the Canal Commission, Admiral Endicott, takes the same position. Five of the American members of the Board of Consulting Engineers and five members of the Isthmian Canal Commission favor the lock canal and so does Chief Engineer Stevens. The Secretary of War recommends a lock canal pursuant to the recommendation of the minority of the Board of Consulting Engineers and of the majority of the Canal Commission. After careful study of the papers submitted and full and exhaustive consideration of the whole subject I concur in the recommendation.

It will be noticed that the American engineers on the Consulting Board, and on the Commission by a more than two to one majority, favor the lock canal, whereas the foreign engineers are a unit against it. I think this is partly to be explained by the fact that the great traffic canal of the old world is the Suez Canal, a sea-level canal, whereas, the great traffic canal of the new world is the Sault Ste. Marie Canal, a lock canal. Although the latter, the Soo, is closed to navigation during the winter months it carries annually three times the traffic of the Suez Canal. In my judgment the very able argument of the majority of the Board of Consulting Engineers is vitiated by their failure to pay proper heed to the lessons taught by the construction and operation of the Soo Canal. It must be borne in mind as the Commission points out, that there is no question of building what has been picturesquely termed "the straits of Panama"; that is, a waterway

through which the largest vessels could go with safety at uninterrupted high speed. Both the sea-level canal and the proposed lock canal would be too narrow and shallow to be called with any truthfulness a strait, or to have any of the properties of a wide, deep water strip. Both of them would be canals, pure and simple.

Each type has certain disadvantages and certain advantages. But in my judgment the disadvantages are fewer, and the advantages very much greater in the case of a lock canal substantially as proposed in these papers forwarded herewith; and I call especial attention to the fact that the chief engineer who would be mainly responsible for the success of this mighty engineering feat, and who has therefore a peculiar personal interest in judging aright, is emphatically and earnestly in favor of the lock canal project and against the sea-level project.

A careful study of the reports seems to establish a strong probability that the following are the facts: The sea-level canal would be slightly less exposed to damage in the event of war; the running expenses, apart from the heavy cost of interest on the amount employed to build it, would be less; and for small ships the time of transit would probably be less. On the other hand, the lock canal at a level of 80 feet or thereabouts would not cost much more than half as much to build, and could be built in about half the time, while there would be very much less risk connected with building it, and for large ships the transit would be quicker; while, taking into account the interest on the amount saved in building the actual cost of maintenance would be less. After being built, it would be easier to enlarge the lock canal than the sea level canal. Moreover, what has been actually demonstrated in making and operating the great lock canal the Soo, a more important artery of traffic than the great sea-level canal, the Suez, goes to support the opinion of the minority of the Consulting Board of Engineers and of the majority of the Isthmian Canal Commission as to the superior safety, feasibility, and desirability of building a lock canal at Panama.

The law now on our statute books seems to contemplate a lock canal. In my judgment a lock canal as herein recommended is advisable. If the Congress directs that a sea-level canal be constructed, its direction will, of course, be carried out. Otherwise the canal will be built on substantially the plan for a lock canal outlined in the accompanying papers, such changes being made, of course, as may be found actually necessary; including possibly the change recommended by the Secretary of War, as to the site of the dam on the Pacific side. THEODORE ROOSEVELT.

The main conclusions of the majority report of the Board of Consulting Engineers, in favor of a sea-level canal, are as follows:

The vastness of the interests to be served by the canal, many of which interests now wait for their development on the construction of the waterway, demands that the canal shall, when opened to traffic, be of the type which will most perfectly fulfill the purposes which the waterway is intended to accomplish.

First and foremost it is essential that the Panama Canal shall present not merely a means of interoceanic navigation—it may be said that any type of canal would enable vessels to pass from ocean to ocean—but a means of safe and uninterrupted navigation, on which no special hazards will be encountered by and no vexatious delays will be occasioned to the vessels which will traverse it. It is therefore evident that the canal ought to be formed in such manner that the course thereof shall be free from all unnecessary obstructions, and that no obstacles should be interposed in that course, whether temporary or permanent, which would by their very nature be an occasion of peril and of detention to passing vessels, and more particularly to vessels of the great size which the Panama Canal is (in accordance with the provisions of the law of Congress) designed to accommodate. The board is of opinion that this consideration should be of determinative force in respect to the type of canal to be adopted, and that it should lead to rejection of all proposed plans in which lift locks, whether few or many, form the principal or dominating features, and consequently to the acceptance of the sea-level plan as the only one giving reasonable assurance of safe and uninterrupted navigation.

It has already been stated as the opinion of the board that the time required for the construction of the Panama Canal with a summit level of 60 feet above mean sea level, will at best be only two years less than required for the construction of the sea-level canal. But as affecting this question of time, it should be observed that accidents during construction leading to an extension of the time required to complete the canal would be more likely to occur in the more numerous structures involved in the building of the lock canal than in the works for the sea-level canal. It has further been shown that the difference in cost between the two plans will not exceed about $71,000,000 in favor of the former, which must be reduced by the capitalized cost of the maintenance and operation of locks and by the cost of the overflowed lands, as before stated. It is seen, therefore, that the lock design has inconsiderable advantage either in time of realization or ultimate cost over the one recommended by the board for adoption by the United States Government, which possesses all the advantages of practically indefinite capacity for traffic, besides a degree of safety and uninterrupted operation which cannot be approached by any lock plan.

It is the belief of the board that the essential and the indispensable features of a convenient and safe ship canal at the American isthmus are now known; that such a canal can be constructed in 12 or 13 years' time; that the cost will be less than $250,000,000; that it will endure for all time.

The board does not believe that a provisional treatment of this great question would yield results which would be satisfactory to the American nation or advantageous to American commerce, or that such treatment would be in consonance with the increase of population, of trade, and of wealth which will surely take place during the next half century in the Western Hemisphere.

THE MINORITY REPORT.

The minority report, signed by Messrs. Noble, Abbot, Stearns, Ripley and Randolph, concurs with much of the majority report, but concludes that a lock canal would be the better one for the United States to construct, for the following reasons:

(1.) Greater capacity for traffic than afforded by the narrow waterway proposed by the board.

(2.) Greater safety for ships and less danger of interruption to traffic by reason of the wider and deeper channels which the lock canal makes possible at small cost.

(3.) Quicker passage across the Isthmus for large ships or a large traffic.

(4.) Materially less time required for construction.

(5.) Materially less cost.

The Isthmian Canal Commission (except for Commissioner Mordecai T. Endicott, dissenting,) concurs in this minority report, and advocates a lock canal for the following reasons:

(1.) It provides greater safety for ships and less danger of interruption to traffic by reason of its wider and deeper channels.

(2.) It provides quicker passage across the Isthmus for large ships or a large traffic.

(3.) It is in much less danger of damage to itself or of delays to ships from the flood waters of the Chagres and other streams.

(4.) Its cost of operation and maintenance, including fixed charges, will be less by some $2,000,000 or more per annum.

(5.) It can be enlarged hereafter much more easily and cheaply than can a sea-level canal.

(6.) Its military defence can be effected with as little or, perhaps, less difficulty than the sea-level canal.

Brief specifications of the plan recommended in the minority report as adopted by the President are as follows:

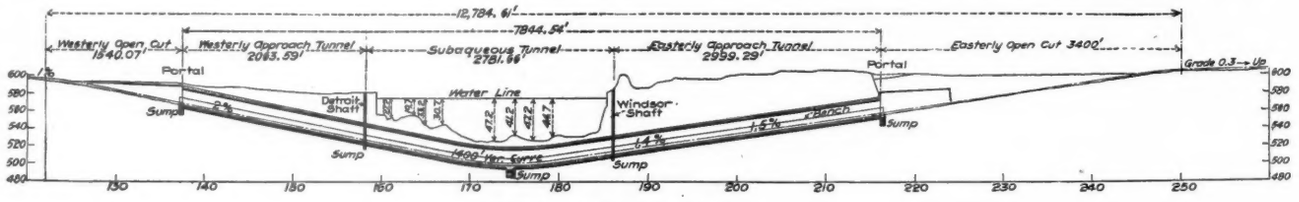
The plan recommended by the minority of the board is a canal with locks, following in general the same location as the other, but with slight variations therefrom in Limon and Panama Bays. Its controlling feature is a dam to close the valley of the Chagres at Gatum, thus creating an artificial lake of which the surface is to be 85 ft. above the sea, and which is to constitute the summit level. The length of this dam will be 7,700 ft., and the height of its crest 135 ft., or 50 ft. above the water surface. It will contain about 21,200,000 cubic yards of material, principally the spoil from the excavation of the canal prism. It is provided with ample spillways and regulating works. A channel 500 ft. wide at sea level leads from Limon Bay to the Gatum dam, where is placed a double flight of three locks, by means of which vessels are lifted into the artificial lake. The lake provides unrestricted navigation for a large part of its length, but becomes more contracted as the Continental Divide is approached until in the Culebra cut the width at bottom is reduced to 200 ft. It finally terminates at Pedro Miguel, where the first lock on the Pacific side is placed, having a lift of 30 ft. By means of this lock vessels are lowered into another artificial lake created by a dam closing the valley of the Rio Grande, and by two other dams closing other depressions, the level of the lake being 55 ft. above the sea. The crests of these dams are 80 ft. above the sea. Communication between the lake and Panama Bay is effected by a double flight of two locks, placed near the shore on the high ground called Sosa Hill. . . . The cost of the canal under this plan is estimated by the minority of the board at $139,705,200, and the time required to build it at nine years.

A correspondent calls attention to the fact that our conclusion on the result of the tests of the New York Central electric locomotive, to the effect that a third rail entirely unprotected is a good deal less troublesome in a storm than a third rail protected in such a way that snow is encouraged to accumulate, is only true as comparing the unprotected third rail with the usual type of protected top-contact rail. He adds that it is a fact that not only during the storm in question, but also during a later drifting snowstorm the unprotected top-contact rail was inoperative, due to the collection of snow, ice and sleet causing excessive arcing; whereas, the under-contact protected rail at all times enabled the locomotive to operate without trouble and proved conclusively that the protected under-contact rail is not only safe as regards human life, but also guards against the evils of interruption of traffic during snow and sleet storms.

The Detroit River Tunnel.

(*Concluded from page* 152.)

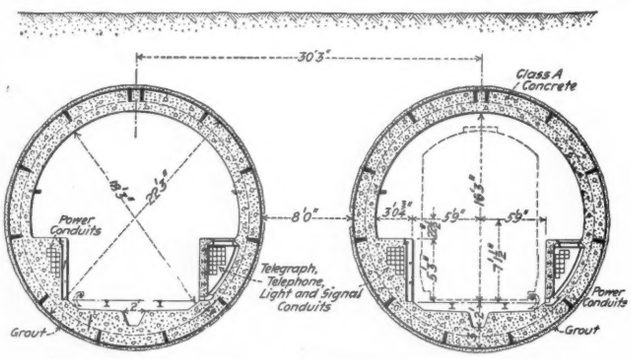
Last week we gave a general outline of the Detroit river tunnel project of the Michigan Central and a description of the three alternative designs for building the tunnel by the trench method. The fourth alternative method, designated as Design D, is the familiar shield method now being used in the tunnels building under the East and North rivers in New York. The shallow depth of the tunnel roof under the river bottom made necessary by the limited approach grades introduces many difficulties in the application of this method, but it is included in the specifications to give bidders an opportunity to submit proposals for a well-tried scheme with which they might be familiar. Were it not for the shallowness of the tunnel the shield method could no doubt be successfully applied in this case as the ground through which the tunnel is to be driven is firm but easily worked in front of the shield without blasting. If the shield is used, thick mats of clay will have to be deposited over the river bottom at the places where the tunnel roof comes dangerously close to the top of the mud to prevent blowing out in front of the shield. The accompanying profile shows the depth of the tunnel under the river and the grades which will be used if Design D is employed.



Profile of Tunnels, Design D.

The cross-section of the twin tunnels, Design D, shows the principal features of the construction which differs but little from that to be used in the Pennsylvania tunnels and the Battery tunnel of the Interborough in New York. The two tubes will be spaced 30 ft. 3 in., center to center, and will be parallel between the shield chambers. They will be lined with segmental cast-iron rings with an outside diameter of 22 ft. 6 in., inside of which will be another shell of 1:2:4 concrete 2 ft. thick. The design of the floor and benches is substantially the same as for Designs A and B. The cast-iron shell will be made up of segmental flanged rings 2 ft. 6 in. wide, and 1½ in. thick. Each ring will be composed of 11 segments and a key segment at the crown. Grout holes are to be provided in each segment for surrounding the outer shell with a thin layer of grout as additional waterproofing.

The specifications cover the method of building with a shield very fully. The shields are to be erected in the shield chambers built out just beyond the shafts, and at least two shields must be used in driving the tunnel to expedite the work. All of the working plant must be built to withstand a pressure of 50 lbs. per sq. in. Bulkheads built of concrete or brick set in cement must be put in at least every 1,000 ft., and when the shield has been forced out 500 ft. from the shield chamber at least two bulkheads must be in use. Each bulkhead must have two working locks 6 ft. x 20 ft. near the bottom for the passage of men and material, a pipe lock 12 in. x 31 ft., and an emergency lock large enough to hold the entire working force at the shield, near the roof. A safety screen must always be in place within 100 ft. of the shield. The working plant above ground must be ample to maintain the necessary pressure in the tunnel, and a spare plant of at least 25 per cent. of the capacity of the normal working plant must always be ready for emergencies. Ventilation in front of the shield is to be provided for with an 8-in. ventilating pipe open to the outside atmosphere and having a suitable pressure regulating valve at the shield.

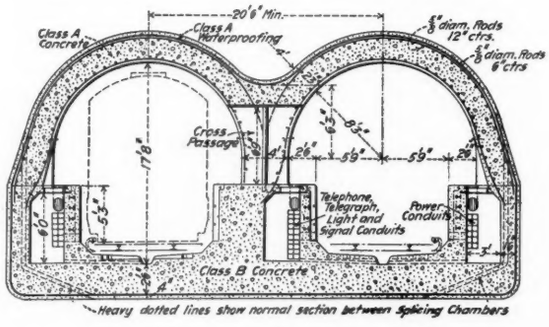


Cross-Section Through Subaqueous Tunnels, Design D.

The approach tunnels at each end leading from the shafts to the portals will be built with timbered open-cuts and back-filled after completion. The cross-section shows the details of construction at a normal section, where the center lines of the two tubes are at a minimum distance from each other of 20 ft. 6 in. Reinforced concrete of a 1:2:4 mixture will be used in the arches above the bench, and a 1:3:6 mixture of concrete, not reinforced for the walls, floor and bench. The tubes will be 2 ft. 7 in. thick at the crown, and will have a full circular arch of 8 ft. 3 in. inside radius. The reinforcement in the crown will be essentially the same as for the subaqueous tunnels, Design A, consisting of annular rings of ⅝-in. rods spaced 6 in. center to center, and longitudinal rods ⅝ in. in diameter, spaced 12 in. center to center, the reinforcement being laid in a mesh 2 in. from the extrados and intrados of the arches. The main body of concrete will be covered with three layers of felt and four alternate layers of pitch, and over this will be laid 4 in. of 1:3:6 concrete to protect the waterproofing. The benches will contain the telephone, power, lighting, telegraph and signal circuits in single-way ducts, as in the subaqueous section. Cross-passages between the two tunnels will be spaced every 200 ft.

The portals will be of 1:3:6 concrete, handsomely decorated and surmounted with a cornice and balustrade. A series of five sumps will be found under each track just outside of the portals, and the two rows of sumps will be separated by a pump chamber. The drawings show pile foundations which will be put in if found necessary when the excavation is made. The retaining walls of the open cut rise to the height of the portal face and continue on out to the end of the cut, reducing in height as the tracks come up to the surface. They are to be stepped on the near face and given a batter of 1 in. to 1 ft. on the front face. Stairs will be built in at both sides leading down from the top of the retaining walls to the level of the bench in the tunnel.

The open approach cut will be built with retaining walls for the first 1,090 ft. from the portal in the Detroit side and for the first 800 ft. on the Windsor side. The walls will have a 4 ft. footing course of 1:4:7½ concrete and a 12-in. coping 3 ft. wide of 1:2:4 concrete, the body of the wall being of 1:3:6 concrete. They will be 29 ft. apart at the top of the footing courses, which allows 13-ft. centers for the tracks. A gas-pipe fence will surmount the coping. The wire ducts will be built into the walls on both sides. The track structure will be 6 in. of quarry spawls laid on the center earth core overlaid with 18 in. of stone ballast in which the ties will be bedded. Sub-drainage is provided for by a line of 6-in. farm tile laid under the paved gutters along each wall. Weep holes or drains through the walls will carry off water collecting behind the walls. Great care will be taken in excavating for the open cuts to prevent caving and damage to adjacent property by draining off water in the soil. Beyond the retaining walls the banks of the cuts will be sodded and given a slope sufficient to hold the sod.

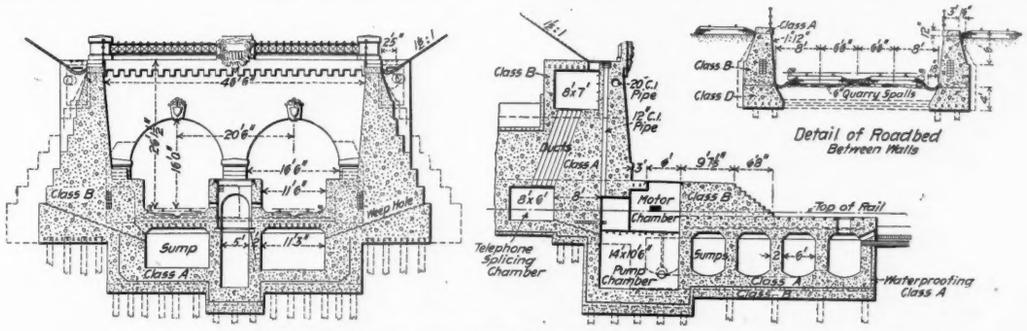


Cross-Section of Approach Tunnels.

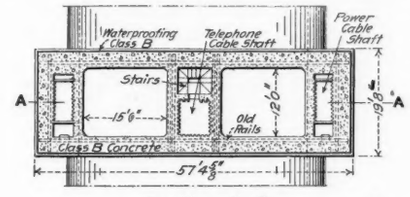
The shafts near the river banks at both ends of the tunnels will provide ventilation and an outlet for the drainage pipes from the sumps as well as an exit in case of an accident in the tunnels. They will be built with double wells 12 ft. x 15 ft. 6 in., and the space between the two wells is of sufficient width for a staircase leading up from a cross-passage at the level of the bench in the tunnels. Two sumps will be built under such track at the shafts and

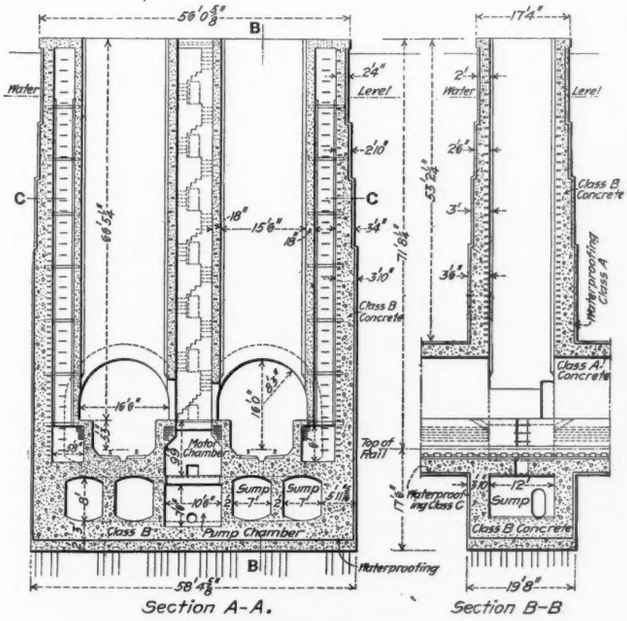
a large pump chamber in between. The sumps will have a combined capacity of 20,000 gallons. Old rails will be used to reinforce the 1:5:6 mixture of concrete, as shown in the drawings. Waterproofing, consisting of 5 layers of felt and 6 alternate layers of pitch, will be laid in the concrete entirely surrounding the shaft and foundations. The excavation for the Windsor shaft is almost completed, this work having been done by the Tunnel Company, which has also begun work on the Detroit shaft.

The specifications for concrete to be used on the work include five classes or mixtures. Class A is a 1:2:4 mixture, using No. 2 broken stone or gravel, which is from 1/16 in. to ¾ in. in its largest diameter. Class B is a 1:3:6 mixture, using No. 1 gravel or stone, which is from ⅛ in. to 2 in. in its largest diameter. Rubble stones not to exceed 1¼ cu. ft. in volume may be used in this class of work. Class C is a 1:1:2 mixture with No. 2 stone. Class D is a 1:4:7½ mixture of No. 1 stone, and Class E is a 1:1½:3½ mixture using No. 2 stone. Grout is 1 cement:1 sand. Concrete may be laid in freezing weather if salt is used or the sand and water are heated.



Details of Portals and Cross-Section of Open Approach Cut.





Details of Windsor Shaft.

The proportion of salt allowed is 1 lb. to 18 gallons of water. All concrete is to be machine mixed.

The estimated cost of the tunnel is between $7,000,000 and $8,000,000. The actual tunneling work under the river is expected to be completed in less than a year.

We are indebted to Mr. W. J. Wilgus, Vice-President of the New York Central and member of the Advisory Board of Engineers, for the drawings and information.

The Government Railroad Monopoly in Italy.*

I.

Although totally unprepared from the technical, economic, and administrative standpoint, the Italian Government and Parliament have taken it upon themselves to solve the railroad problem. In 1885 contracts were stipulated by which the Italian railroads were divided into three great systems, i.e., the Adriatic, the Mediterranean, and the Sicula roads; the first two in Continental Italy divided the country longitudinally in the Adriatic and Tyrrhenum directions, the third was for Sicily.

The companies paid the Government $53,000,000 as value of the railroad material, and the Government agreed to pay their annual interest charge of $369,730. The chief conditions of the above-mentioned contract consisted in fixing a percentage of 27 frs. 50 centimes (5.25 per cent.) on the gross returns, which the railroad companies were to pay the Government annually. This percentage was to be increased if the gross returns exceeded the limits of the initial gross returns, which were fixed at $44,000,000. Ordinary and extraordinary expenses were to be paid by the companies.

Reserve funds were instituted, to which 10 per cent. of the initial gross returns, and 15 per cent. of later returns, were devoted, for the purpose of meeting unavoidable emergencies, for the renewal of railroad metal and other material, and lastly for the improvement of the lines and increase of material. Since a considerable portion of the rails belonged to the Government, the surrender of the railroads to private companies assumed the character of a lease rather than that of a private business. When one adds to this that the condition of the rails was deficient, and that the material was worn and scant, it will easily be understood that the new administration was inaugurated under unfavorable auspices and commenced badly.

A special office of General Railroad Inspectorship was instituted, the object of which was to control the service, and take care that the conditions of the contract were respected. A Board of Tariffs, so-called, was further added, to which delegates of the Government and of the companies were appointed, the object of which was to make such alterations in the tariffs as the economic conditions of the country might render opportune.

But the defective condition of the roads, the mistaken working methods, and the obstacles created by the contract conditions, rendered a rational and proper railroad system impossible, and the companies barely obtained a scant interest, which did not surpass 6 per cent. on the capital paid to the state; and only by the concession of the construction of the new rails, were the companies enabled to continue carrying on the railroads, which in certain years, especially for the Mediterranean line, returned scarcely any profits.

The Government, on its side, while apparently enjoying the stipulated percentage, was in reality obliged to spend a considerably larger sum in aid of the scant reserve fund; and the country had to put up with inadequate service and very high tariffs. As soon as the conditions of the contract were enforced, the results proved to be quite different from what had been expected, and consequently the reserve funds fixed for the improvement of the road and material did not suffice, and the Government was compelled to have recourse to the Treasury so as to make up for this, but always did so tardily and inadequately.

The companies, on their side, with an insufficiently developed property, vainly begged the Government to attend to the matter, and meritorious as the efforts made by the companies were, the railroad service could not prove other than inadequate to the requirements of the country. Not one of the ministers who succeeded one another in the course of 20 years realized that it was his duty to lay the real state of the case before Parliament; all did their best to conceal it, and while the Government allowed the

*The author of this paper, which is the first of a series dealing with the subject, has had intimate connection with the Italian railroad system for many years. On this very account, he prefers to have his name withheld.—EDITOR.

railroad capital to dwindle, the Ministers of Public Works—in order to keep themselves clear of all responsibility—deceived the Parliament by laying all the blame for the bad service and continual unforeseen expenses which the Treasury was compelled to pay, at the companies' charge. For, much as the Government has attempted to avoid the grave responsibilities incurred by its short-sightedness, and inadequate as are the present conditions of the Italian railroads to the requirements of the life and commerce of the country, it is none the less a fact that the Government has, during the past 20 years, subscribed $40,000,000, besides the enormous capital spent on new railroads.

Moreover, the Railroad Inspectorship, which the Government created to control the railroad service, to study its defects and suggest remedies therefor, was transformed into a legal office, which wasted its time and energies in fruitless quarrels with the companies, and seconded the Ministers of Public Works in their efforts to deceive the country regarding the real cause of the railroad difficulties, i.e., the inadequate condition of the railroads, the lack of rails, and the conditions imposed on the service. Thus the inspectorship so far lost its technical character that a barrister was appointed as Director.

In like manner, the Board of Tariffs, which might have rendered real service, was paralyzed in its functions, being rarely summoned, and then only to consider matters of secondary importance. In this way the action of the inspectorship was rendered null, on the one side, while on the other, public opinion was misled by the convenient system of laying all the blame on the companies.

This system, while screening those really responsible, created a current of opinion of which the extremist parties availed themselves, and thus Socialists, Radicals and Republicans advanced state monopoly as their program, in their wrath against the companies, which were denounced as those solely responsible for the disgraceful railroad service. In support of this opinion, the many complex questions connected with the grave railroad problem were neither examined nor discussed, while appeal was made to the mob and to the railroad staff.

Public meetings were called, and, totally ignorant of the true state of affairs, passed votes in favor of state monopoly. The railroad staff rebelled, imposing terms and conditions on the Government, and ended by declaring the strike which an inefficient minister was incapable either of foreseeing or tackling. Those acquainted with railroad problems demonstrated that it was a question of substance, not of form, and that the first necessity was to develop the railroads, and complete the lines, thus inaugurating a more logical and rational service. Thus it came about that while the most competent and authoritative statesmen had always declared themselves opposed to state monopoly, they finished by giving in to the weight of public opinion and threats, and only a few isolated men held to their convictions. The Government also went with the tide, and, taking a leap in the dark, proposed the bill for state monopoly, which was hurriedly passed by both branches of Parliament, without any kind of preparation, under the pressure of the railroad strike.

This hurried manner of solving so grave a problem presented one advantage only; it served to conceal the responsibility of those who had brought about the disastrous state of affairs, in which both the Government and private management would have found the Italian railroads in a deplorable condition, and, what is worse, with a working system opposed to all practical and rational notions.

Private Cars and the Fruit Industry.*

The shipment of fruit under refrigeration was not originally Armour's idea. As far back as 1868 fruit had been transported under ventilation or partially iced. Swift transported iced beef with established success in 1880, but it was not until 1888 that any one was daring enough to attempt the costly transportation of carloads of fruit under complete refrigeration from California. In 1888 several men, Hutchins, of Detroit; the Thomases, father and son, of Chicago, and the Hubbard brothers, after experiments with the shipment of iced fruit in Michigan and from the South, demonstrated the practicability of a thorough iced car service from California, and the next year staked everything they had upon their idea, and induced a few growers of cherries and apricots in California to try their new cars.

In spite of every obstacle, Thomas and his associates were successful—unexpectedly so. Upon their almost forgotten efforts, indeed, rests much of the present prosperity of California. They organized the California Fruit Transportation Company, and within three seasons, so amazing was their success, that they owned over six hundred cars—and their profits were really fabulous.

But they quarreled with the Earl Fruit Company, one of the largest fruit shippers of California. Undeniably they themselves became greedy. Earl went to Chicago and tried to make terms with them. When he failed he approached Armour and made arrangements to rent some of his refrigerator cars in the fruit industry. He also got hold of certain patents and organized two refrigerator car lines of his own. Backed by Armour, whose influence with the railroads was supreme, Earl began a fierce contest for the business. He paid rebates for the first time on the California fruit business. In two seasons Thomas was utterly defeated and finally, after disastrous experiments in shipping fruit to Europe, the California Fruit Transportation Company was sold out, name, idea, business and all to Swift & Co.—and Swift & Co., of course, is a part of the "beef trust."

Armour now perceived the brilliant opportunities for profits in the fruit-shipping industry. He developed his business rapidly. For some time he worked on terms of apparent friendliness with the Earl Fruit Company. But Earl was a man of great energy and capacity, and he developed so much aggressiveness and his profits were so glittering that Armour decided to eliminate him. . . . Having crushed his last rival, Armour rapidly broadened his activities, reaching out for more and more of the profitable fruit business of the country. To-day he owns and operates some 14,000 refrigerator cars, worth over $14,000,000; he not only controls most of the fruit transportation of California, and therefore the destiny of the fruit-growers themselves, but he penetrates the peach-growing districts of Michigan and Georgia, and the strawberry fields of North Carolina; he brings tropical fruits from Mobile and New Orleans, melons from Indiana and Illinois, and early vegetables from Arkansas and Missouri.

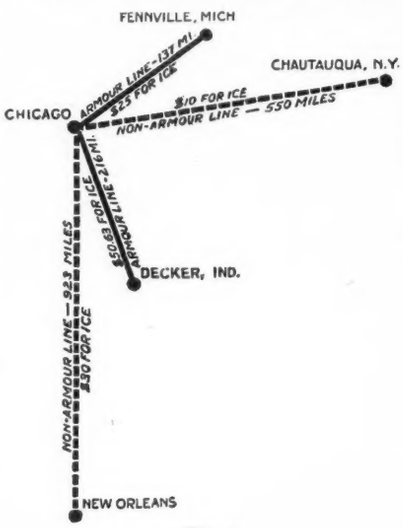


Fig. 1.

Having crushed his private-car rivals in the fruit industry, Armour now began a new campaign. The railroads themselves had been buying refrigerator cars, and offering them for the shipment of fruit and dairy products. So Armour went to various railroads and proposed or demanded that they make contracts with him for the exclusive use of Armour refrigerator cars. He pays over $200,000 a week in freight at Chicago alone, and vast sums elsewhere. By giving his business to one railroad and taking it from another he could almost make or ruin the profits of the companies concerned. Here was the Pere Marquette Railroad, for example, over which was shipped the bulk of the fruit grown in the rich districts of western Michigan. The Pere Marquette was a weak railroad, hungry for more traffic. Armour went to the eager officers of the Pere Marquette and guaranteed to give them forty cars of meat a week, in return for which the Pere Marquette agreed to use none but Armour's cars for its fruit shipments. The Pere Marquette had a few refrigerator cars of its own with which it had served its customers; but under the new contract it could not supply its own cars to the people along its own line.

It is the theory of the private car that any shipper can own cars and have them shipped over the railroad. Armour says plausibly enough to his rivals who complain:

"Why don't you get your own cars—if you want to do business on an equality with me?"

But these competitors, even if they bought cars, could not ship them over the Pere Marquette Railroad because Armour had prevented the use of any cars but his own anywhere on that railroad. And the Pere Marquette was not the only road affected. No railroad in all the great fruit country of the South was at liberty to use any refrigerator cars except Armour's. About the only fruit-originating railroad of any importance which he did not get was the Santa Fe, which does its duty by its clients by owning its own refrigerating cars, although it charges the same icing rates as Armour and has indulged in the same methods of paying rebates. The Pennsylvania Railroad and the Gould lines also own their own refrigerators and have refused to make exclusive contracts with Armour.

Armour's really valuable service is to roads like the Pere Marquette. They found it a burden to buy and own enough refrigerator cars to handle all the fruit business on their lines, because fruit shipments are crowded into a certain short season. Armour could send his cars to Florida or to California in the winter, and could employ all his cars all the time, which is an economic saving and therefore a service to the people. * * * The very life of these hard-working Michigan farmers depended on railroad service, and they

*Extracts from an article in McClure's Magazine, by R. S. Baker.

were naturally willing to pay almost anything rather than to perish industrially. But can we, after all, excuse Armour on the ground that the railroad did not do its duty?

From Paw Paw, Michigan, to Dubuque, Iowa, the icing charge before Armour's reign was $10 on the average. After Armour got possession it increased to $37.50. To Boston from Grand Rapids, before Armour, icing cost $20 a car; after Armour, $55.

A shipper went to Grand Rapids and tried to reason with Armour's representative there. He explained how unreasonable and unfair such charges were; how, in the end, they would serve to limit the fruit production of Michigan and therefore reduce the business of the Armour car line itself, let alone that of the railroads. When he had finished speaking Armour's man looked up and asked:

"Well, what are you going to do about it?"

The Iowa markets, which had been profitable to Michigan growers, were almost entirely closed after 1902.

But conditions in Michigan, bad as they were, cannot be compared for downright hopelessness with that of the fruit growers of California. The longer the distance shipped, the more dependent the shipper becomes.

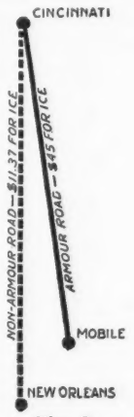


Fig. 2.

J. A. Leverone, of Cincinnati, made two shipments of pineapples, one of fourteen cars from Mobile over the Louisville & Nashville, which had an Armour contract, the other of ten cars from New Orleans by the Illinois Central, which had no Armour contract. The distance from New Orleans to Cincinnati is greater than from Mobile to Cincinnati. On the Armour cars the icing charge was $45 each, on the Illinois Central cars the charge was only $11.37 each—one-fourth as much. At the same time Armour shipped pineapples and sold them at his own branch stores in Cincinnati in competition with his client Leverone. And he sold for $35 a car *cheaper* than Leverone—or just about the profit which he made out of Leverone on ice. What chance could there be for a shipper against Armour under such circumstances?

Of course, Mr. Leverone objected; his very business existence was threatened. He refused to pay the charges. The officials of the Louisville & Nashville Railroad threatened him, * * * but finally settled with him, refunding the icing charges. Then the Louisville & Nashville issued an order withdrawing the high Armour rates from Mobile to meet the Illinois Central competition at New Orleans. But the poor fruit growers on parts of the Louisville & Nashville, who had no other railroad to help them out, were still wholly at the mercy of the Armour monopoly—and are to-day.

Injuries to Employees.*

We next take up injuries to employees caused by the carelessness of other employees; first, as in the case of passengers, those caused by collisions. From the number of collisions on the main track and in yards one would almost think that the general and fundamental customs and rules on railroads that "In case of doubt always adopt the safe course," and that "Speed must always be sacrificed to safety" were seldom observed; but I do not think that is so. On the contrary I believe it to be the exception and not the rule, else the number of accidents resulting from such failure, though many times in number what they should be (and as long as men are human we will have some accidents), would be so much greater in number that people would be unwilling to travel at all. Yet I have the faith to believe that in the near future the number of such cases will be so greatly reduced that the least thoughtful of us will stand aghast at the record of 1903 and 1904, and that these fundamental rules and the instructions contained in what are known as the "Flag Rules," and "Caution Card," will be so strictly observed and enforced and that blocking of trains by space, not time, intervals will become so general as to practically eliminate this class of accidents, which are caused: By failure to watch for and observe block and other signals; by trains following each other too closely; by trains following at too high a rate of speed; by failure to protect trains stopped on the main track; by cars not being left in to clear at sidings; by switches being left wrong; by lack of caution in time of storm or fog; and by general carelessness and failure to realize the terrible result which is bound to follow any lack of care, failure to comply with the rules and the uncertainty of detection and punishment if such carelessness and failure to comply with rules does not cause an accident.

Every man in the train, engine, and switching service ought to have every requirement of these rules by heart, understand exactly what they mean, and be ready at any instant, and in any weather, to execute them to the letter, and no punishment should be too severe for failure to observe them to the very letter, for on their faithful observance depend the lives of passengers—it may be some of your own loved ones—of employees, and the safety of the property entrusted to the company for transportation, as well as its own. And yet, if the instructions contained in the two fundamental rules and those known as the "Flag Rules" had been observed, none of the following cases and many others that help fill the records of my office and the daily press would have happened. It is a standing disgrace to the service that such accidents happen, and the sooner you help get the careless and reckless men and the drones out of the service, as it is your duty to yourself and the company to do, the quicker the traveling public, yourselves, the property in transit, and that belonging to your employer and yourselves will be safe and the greater your certainty of getting to the end of your run to be welcomed by the wife and children awaiting you.

In this connection I want to suggest to the enginemen that when you discover a cause for the sending out of a flagman give him a chance to go back before you get stopped, so that he can cover the required distance quicker. And as these rules are among the most important, if not the most important, in the book, I give the substance of them as I understand them.

Flagmen shall have for day signals not less than two torpedoes and a red flag; for night signals not less than two torpedoes, two red fusees, and red and white lanterns; conductors shall see that flagmen have these signals when they go on duty.

When any train makes an unscheduled stop (whether at a station or between stations, or whether such stop be caused by accident to the train, or by signal, or in any other way), the train shall be protected as follows. In the night time the flagman shall immediately place a lighted red fusee in center of track about 500 ft. behind the rear of train. He shall then go back as rapidly as possible with red and white lanterns to a point not less than three-fourths of a mile (24 telegraph poles) distant from rear of train and until he reaches a point where the danger signal can be seen not less than one-fourth of a mile (eight telegraph poles) by the engineman of any approaching train. When the character of the road or weather makes it necessary the flagman shall go a greater distance with signals, so as to insure absolute safety. In the day time he shall carry a red flag and proceed to a like point. When he reaches such point, whether in the night time or day time, he shall at once place one torpedo on the rail on the engineman's side and shall remain at that place until recalled. If a train approaches he shall flag it and remain until the train stops. When recalled, if no train is approaching, he shall place a second torpedo on the rail 200 ft. nearer his train and return with all possible despatch.

When any train makes a scheduled stop at any station, and occupies the main track longer than usual at that station, whether on account of baggage, passengers, or for any other reason whatever, the flagman must protect his train in the same manner.

When any train has been stopped by a preceding train in the manner above mentioned, the flagman of the last train must protect his train in the same manner.

When it is necessary to protect the front of a train, it shall be done in the same manner.

In all cases above mentioned it shall be the first and immediate duty of conductors to see that flagmen obey this rule. Both conductor and flagman will be held responsible. When a flagman goes out, the next brakeman or baggageman must take his place on the train, as required by Rule 248.

The engineman on approaching train, on seeing flagman's signal, shall immediately indicate it by one short blast of the whistle, and immediately reduce the speed of his train and find out the purpose of the signal, and if he does not hear the second torpedo he will bring his train to a stop. If the engineman on approaching train sees no signal (the flagman having been recalled), but hears the first torpedo, he shall reduce the speed of his train and thereafter proceed cautiously, and prepared to stop within vision, until he is notified by signal or otherwise that the track is clear. On hearing the second torpedo, the engineman will know that the flagman has been recalled and will proceed cautiously, keeping a sharp lookout for train ahead and prepared to stop within vision, until he is notified by signal or otherwise that the track is clear. If a fusee is seen, the engineman shall not pass it until it is burned out, and thereafter shall proceed cautiously and prepared to stop within vision, until notified by signal or otherwise that the track is clear.

When the whistle is sounded recalling the flagman if there is not a clear view to the rear for one-fourth of a mile (eight telegraph poles) the train should be moved ahead at a speed of not less than six miles per hour, until a point is reached where the track is straight for one-fourth of a mile in the rear of the train, always bearing in mind that the time of the flagman's return is the period of greatest risk.

The following cases will illustrate how much room there is for improvement in this regard:

Joseph Atkinson, brakeman, injured Sept. 26, at Muggleton. He was

*From a paper prepared by the Claim Department of the A. B. & C. Railroad, parts of which appeared in the *Railroad Gazette*, of Dec. 15 and Jan. 5, under the headings "Injuries to Passengers" and "How to Avoid Accidents."

standing on top of way-car in train hauled by engine No. 1392, which stopped just west of the depot and then started up and ran into side of freight train.

Alexander Peabody, engineer, George F. Smivins, fireman, injured at 10 p. m., Oct. 3, on track 3, near Penryn Ave., Peltonville; engine No. 784, was backing down track 3 and collided with engine No. 1891 standing on that track. Instructions require engines running on this track must run at slow rate of speed, so as to be able to stop within their vision. The engine was running so fast that it could not stop, although Engineer Peabody saw engine No. 1891 when 300 ft. distant.

J. L. McPherson, yardmaster, and Jacob Gonorowski, brakeman, injured at Peeweezle, July, 28, were in caboose of extra engine No. 674, which was stopping for drawbridge, when engine No. 937, engineman Isidore Guggenheimer, ran into the rear of train.

Luke M. Peters, engineer, injured April 14 at Aromintap, was in charge of engine No. 2143, backing around Y, when train No. 31 backed into extra No. 7326, to which engine No. 2143 was attached.

L. P. Jarvis, engineer, T. J. Tibbits, engineer, Rupert Leggett and Samuel Minns, firemen, injured Nov. 20, at 7:15 a. m., one-half mile east of Peeble's Corners; engine No. 759 had just backed in on side track with work train, and switch had not yet been closed; engine No. 1473, train No. 48, Engineer Tibbetts, Conductor Perry, came along at a high rate of speed, and ran into this open switch just east of the home signal, colliding with engine No. 759.

Rules 418 and 419 say: When you get a train order, conductors must read it aloud and then sign it and show it to the engineman, the rear brakeman or flagman, and the engineman must show it to the fireman and in case of freight train to the head brakeman, who are required to read it, the object being that every employee on the train will know what the order is and if the engineman or conductor forget it the brakemen or fireman may remember and by remembering prevent an accident.

Next come injuries caused by derailments, which generally result from running into open switches, off derails, too fast running at bad places in the track, defective equipment or track. Nearly all of the cases would be avoided by careful running, proper inspection of track and equipment, and by compliance with the rules of the company.

John D. Mickles, engineman, Samuel R. Smetzel, fireman, Michael Stubbs, tramp, and unidentified tramp killed, and seven others, including a telegraph operator, injured one and one-half miles west of Daisy Centre, May 21, 1904, by train No. 36 running off derail and knocking down tower. There seems to have been no pretense of complying with Rule 396, requiring conductors to show their orders to rear brakemen and flagmen, and enginemen to show their orders to the firemen. Train passed Daisy Centre 5 minutes ahead of time, running 60 miles an hour in a terrible rain storm.

P. T. Bines, brakeman, killed by derailment of train No. 17, between Merrieton, and Swimmel, Aug. 15, 1904, at 6:10 p. m. From the investigation it appears that this derailment was occasioned by fast running. A bulletin was issued by Superintendent Rathencrest, June 30, 1903, prohibiting trains going down this hill faster than 30 miles an hour. From the statements of all the train crew it would appear that no attention has been paid to this bulletin, and from what the passengers say it has been customary for a long time for trains coming into Swimmel from Werehere, and from Racketico, if in sight of each other, to make the race to see wheich train can get there first, so as to get to Eppskokee first.

Lemuel Izzard and L. Wackles, killed; R. P. Bownes, engineman, Roderick Bloke, stockman, Robert Castel, fireman, C. Plympton, brakeman, injured, four miles west of Beadleston at 1:48 p. m., July 24. Train No. 36 had broken air hose or axle, derailing and throwing third car from engine onto westbound track just as train No. 98 was coming. Train No. 98 ran into derailed car and 14 cars of time freight burned up. Izzard and Wackles were stealing a ride on Train No. 36.

I shall next call your attention to accidents caused by defects in the equipment, especially in that of freight cars and engines. They are of so frequent occurrence as to no longer attract attention, but when the time comes that the man who inspects reports not to the foreman, whose duty it is to keep the equipment in repair, but to a superior, whose duty it is to find defects, there will be a material reduction in such cases. Train and enginemen should report defects discovered by them on Form 995 and attach card to truss rod of car or locomotive tank. And first we will take up those caused by defective cars:

J. I. Smindorf, brakeman, killed at Snook's Junction, by falling from car No 667, Sept. 8, at 7:40 p. m. This car was delivered to us at Pealey, Sept. 7; the running board was rotten and full of holes; the brake at the north end of car would not hold on account of having a loose ratchet wheel.

P. L. Merritt, conductor, injured at Pencost, Nov. 12, was climbing down side of O., J. & G. car No. 9168; screw pulled out of top hand-hold, allowing Merritt to fall to the ground, striking on a rail and injuring his hip, back and side.

Randolph Smuck, brakeman, injured at Parrott, April 3, was going down side of A., B. & C. car No. 4721; stirrup was gone and he fell to the ground, spraining his back.

Matthew Brummage, switchman, injured Jan. 4, at Keewahtah, was riding on A.,. B. & C., flat car No. 5935, which was being switched; he tightened the brake, but the dog was in bad order and he had to hold brake tight with his hand. There was two inches of slack on the bottom brake rod, the chain slipped, and he was thrown from the car and his left foot run over.

How many of the accidents caused by defective running boards, hand holds, ladders and brakes would have been avoided had Rules 741, 742, and 756, requiring trainmen to examine cars, brakes, and ladders and to set out bad order cars been complied with, I leave you to guess. And why when such defects are discovered by train and yard men they do not report them to the next crew taking the car, so as to prevent any of the latter being injured, I never could understand.

One cause of the great increase in accidents by trains breaking in two and by defective couplers is probably on account of the fact that many of the automatic couplers are commencing to wear out and are not repaired or renewed promptly enough, and, also, because the levers and chains of the coupling apparatus do not receive sufficient attention. Another reason is because of the unnecessarily hard usage given the couplers, especially in the yards where trains are made up. Just why an appliance to save life and limb should be abused by the employees, for whose benefit it was put on the cars and engines, is one of the things which it would take a mind-reader to answer. But the truth of the matter is, as every experienced adjuster knows, that the automatic coupler has cost the railroads for equipment and freight damaged many times over what it cost them to settle claims for personal injuries caused by the old link and pin coupler; and when the brotherhoods take up such matters as this and try to remedy them, they will not have so many crippled members drawing insurance for permanent disabilities, which would have been avoided by the proper handling of cars.

Another class of injuries which has come with the safety appli ance is that caused by the bursting of air hose, and it is surprising how many of them there are.

Some day a man will get up a hose which won't burst, or which will give notice of its intention so to do, and we will all rise up and bless him. The following are samples taken from a job lot of such cases:

G. A. Graham, conductor, injured June 4, three-quarters of a mile north of Bogle; caused by air hose on A., B. & C. car No. 3864 bursting, causing Graham to fall against stove in way-car.

K. L. Grobbet, brakeman, injured one mile north of Brandon; caused by the air hose bursting, throwing on emergency brakes. This man, who was in front end of way-car, was thrown to the ground.

Now let us see the result to persons by reason of improper loading of cars:

R. Puddles, switchman, injured at Grammaton, March 4, was hanging on side of A., B. & C. car No. 2479, loaded with lumber, engineman shut off suddenly, and when car stopped the lumber slid and caught his hand between lumber and stake on car. Lumber was loaded in two piles 16 ft. lengths, leaving a space of about six or eight inches between the piles.

George Brownell, brakeman, injured July 17, one and one-half miles south of Cranton, At Cranton train extra, engine No. 1020 picked up A., B. & C. car No. 7841, loaded with logs; two stake pockets broke; logs fell under way-car, which tipped over, injuring Brownell.

And it is just as important to properly unload packages of newspapers and mail from moving trains, and to exercise a little care in throwing coal from engines, as it is to see that freight is securely loaded. The number of accidents caused in this way since the running of fast mail and newspaper trains commenced would fill a book and could all have been avoided by the exercise of that care which employees or postal clerks would have exercised if they, instead of the company, had to foot the bills caused by their carelessness. To me, it seems not a difficult or unreasonable precaution to look, before you throw out a heavy bag of mail or half a dozen packages of newspapers, to see that no one will be hit by them, and that they could and should be dropped just beyond the far end of the station platform, but never in a street or public highway; and don't throw your clinker bars or ash bars off engines, or anything else for that matter, without looking to see if anyone is passing and when through with them put them in a safe place so they won't project and strike anyone on the next track or fall off and injure someone. If this had been done cases like the following would not have happened:

Henry Forbes, roadmaster, injured Nov. 3, at Marionette, was walking west on station platform, when mail sack was thrown from train No. 68, struck him on the legs and knocked him down.

Paul Rhelips, injured at Dragitt, May 15, at 5:30 p. m.; caused by his being struck with a block of hard wood which was tied to a letter thrown from train by the baggageman, while passing through the station at 45 miles per hour.

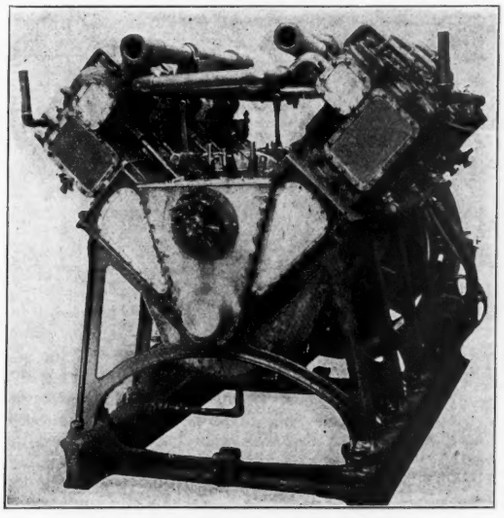
The Strang Gasolene-Electric Rail Motor Car.

The accompanying illustrations show an experimental gasolene-electric rail motor car built by the J. G. Brill Company for the Strang Electric Railway Car Company. This car has made a number of experimental runs near Philadelphia recently, and is now on its way West to have further experiments made with it. The propelling apparatus consists of a six-cylinder gasoline engine direct connected to a direct-current dynamo in the engine compartment, a starting rheostat, storage battery mounted under the car, a series-parallel controller and two motors on the axles.

The engine is of special construction, and includes a number of governing devices which are unique in design and operation. It was built by the Strang Electric Railway Car Company, and designed by its chief engineer, Mr. Lars G. Nilson. It is of the four-cycle type, and has six 8 by 10-in. cylinders. To secure a short crank shaft and reduce vibration to the minimum, the cylinders are partially opposed, three on each side, and are set at an angle of 90 deg. to each other. An advantage of this construction is in the

accessibility of the parts. The bearings and wearing surfaces in general are large, but the weight of the entire engine is reduced by using aluminum for covering parts where there is no strain. The engine frame is a substantial cast-steel structure, securely bolted to a rectangular base of the same material. The vaporizer is arranged to work with the utmost economy with all kinds of loads. Kerosene, alcohol or crude oil may be used instead of gasolene with a slight change of adjustment of the vaporizer. The ignition is of the high-tension, or "jump spark" type, with coils of a special design, one coil for each cylinder, and all operating from one interrupter. The commutator is driven from the end of the cam shaft and is outside the casing at the rear of the engine. The oil is contained in a reservoir placed beside the base of the engin and pumped to the different bearings; it is returned to a filter located over the reservoir. A centrifugal pump belted to the flywheel draws water from a tank in the vestibule at the center of the car and forces it through the cylinder jackets and to radiating pipes upon the roof. In cold weather the passenger compartment is heated by the water from the cylinder jackets. The gasolene is stored in a tank underneath the car floor, and is pumped to an overflow cup at the side of the vaporizer and the excess returned by another pipe to the tank. The cells of the storage battery are placed on a cradle underneath the center of the car. By the use of 250 volts instead of the usual 500 the number of cells is reduced and a more reliable insulation is secured.

Experimental Strang Gasolene-Electric Rail Motor Car.



Six-Cylinder Engine and Frame.

The electrical equipment consists of a 50-kw, 250-volt, d.c. generator, 400 r. p. m. directly coupled to the gasolene engine; two 50-h.p. series-wound motors of the regular street railway type, two K-13 controllers, and a storage battery of 112 cells having 200 ampere-hours' capacity.

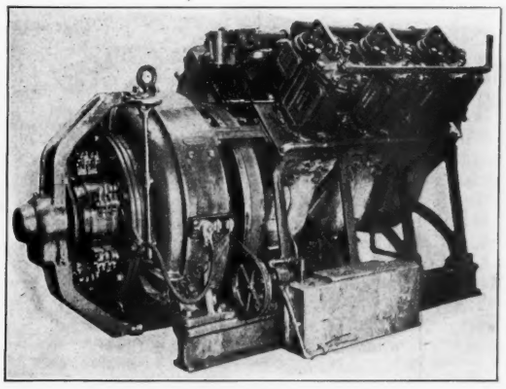
When running on a level track under ordinary conditions, the current goes directly from the generator to the motors, but when coasting down grade, slowing up or standing still, the surplus of current is taken up by the batteries and furnishes the extra power necessary for acceleration, and for ascending steep grades. This arrangement is entirely automatic and does not require to be watched by the operator.

The use of a direct-connected gasolene engine requires one which is large enough for the maximum load, therefore, it runs most of the time at one-third its normal power. In the Strang system the storage battery enables the engine to run practically at the same speed at all times, with the air and fuel adjusted but once and for the best possible combustion. The battery acts as a balance or equalizer and the engine takes care of the normal load. The battery is of comparatively small size, as it is rarely called upon to furnish current for more than a few minutes at a time.

The engine is provided with automatic governing devices dependent entirely upon the condition of the batteries and the consumption of current. This arrangement has nothing to do with the speed of the engine or the motors, but is simply an additional safeguard against overcharging the batteries, and is entirely automatic and solely for the purpose of economizing fuel and saving the battery when the car is running light or standing still. The switchboard is placed against the left side of the engine compartment within easy reach of the operator. It includes voltmeter, ammeter, starting rheostat and spark control. The platform at the rear of the car is equipped with a controller and a combination volt- and ammeter.

The maximum speed of the car which can be maintained is 50 m. p. h. The average gasolene consumption is 0.45 gallons per car-mile. One hundred gallons of gasolene are carried, which gives a mileage radius of 225 miles.

Several cars of this type are now being built by the J. G. Brill Company for the Missouri & Kansas Interurban Railway, to be used on the line running over the old Santa Fe trail from Kansas City, Mo., to Olathe, Kan. These cars will closely resemble standard interurban cars, will be 52 ft. 9 in. long over vestibules, and will be mounted on Brill 27-E trucks. They will be divided into an engine compartment in front, 14 ft. 8 in. long, a smoking compartment 10 ft. 8 in. long, and a passenger compartment 27 ft. 5 in. long. Accommodations for 41 passengers will be provided.



Engine and Dynamo.

The patents on the Strang System are controlled by the Strang Electric Railway Car Company, 15 Wall street, New York City.

Technical Considerations in Electric Railway Engineering.

On January 25 the London Institution of Electrical Engineers considered an exhaustive paper, under this title, read by Mr. F. W. Carter. If we quote his last remarks first the author's object may at once become apparent: "There is at present a little natural conservatism amongst railroad managers, and a disinclination on the part of directorates to sanction the outlay of a large amount of capital when the best system of operation appears to the superficial observer still a matter of speculation. It is hoped that this paper will serve in a measure to define the spheres of usefulness of the several systems of electrical operation, or at least to

prove that the most suitable system can be determined in any particular case."

Mr. Carter did not take up the economic engineering aspect of railroad electrification, nor did he describe particular apparatus and material, preferring rather to deal with the technical side of the problem. He contended that it was because generalization had been attempted without detailed investigation that so much misleading information had been published tending to create and foster the idea among railroad men that electrical engineers did not really grasp the conditions of railroad work.

Details were given of the methods employed in investigating the preliminary and exact engineering features of the electrical system, the author's work being based for the most part on the use of continuous current railroad motors, as applied to suburban service under conditions obtaining in England.

The engineering details throughout are affected by the size, importance and location of the system. Where but few trains are operated these may with advantage be made smaller and arranged to accelerate at a lower rate than might be advisable and practicable in the case of a large and crowded system, in order to diminish the overload capacity necessary in generating and distributing systems, since this is likely to govern the capacity of the plant. Suitable provision must always be made to minimize the trouble and delay due to a breakdown, but the amount of capital that can be economically sunk in spares, duplicate feeders, and stand-by plant will depend largely on the importance of the system.

Mr. Carter took as being available for railroad service (1) the continuous current system; (2) the single-phase alternating current system, and (3) the polyphase system employing induction motors, remarking that the numerous alternative combinations of service and system could mostly be disposed of when general principles had been elucidated. At considerable length, and by the aid of a number of train resistance, motor, energy consumption, acceleration and other curves, he showed how, from the requirements of the service, the dynamical characteristics of the motors necessary for driving the train may be deduced. There is not at present a general agreement as to how railroad motors should be rated, though the rule most generally followed was that of the Committee of Standardization of the American Institute of Electrical Engineers. That rule is not by any means universally followed in England—the motors on the Liverpool Overhead Railway being an instance of this. A brief account of the methods of making service tests and of expressing results, as developed by the General Electric Co. of New York, was given, and later Mr. Carter endeavored to show why, under suburban conditions, the single-phase alternating system compares very unfavorably with the continuous current system. Some of the disabilities of the single-phase system disappear at low speeds, where the equipment weight is in any case a smaller fraction of the train weight and its increase therefore of less importance. Again, a service involving infrequent stops and moderate speeds, where the input per ton is small and the motor losses can accordingly be kept within reasonable limits, may often prove quite suitable for operation by the single-phase system. In short this system shows promise of having extensive, but by no means universal, application to railroad work.

The polyphase system, employing induction motors, has the disadvantage of requiring two or more overhead conductors, which complicates matters considerably at junctions, although it is not so serious an objection on continuous track. It is not well suited for suburban or other service in which stops are frequent and a high rate of acceleration is necessary. With tandem-parallel control about one-third of the input during the time of controller acceleration is wasted in rheostats, and since controller acceleration is continued until practically full speed is reached, after which the power required is small, the waste in rheostats is nearly one-third of the whole input if stops are frequent. It is true that some of the energy of the moving train can be recovered when stopping, but only by imposing extra duty on the motors and so diminishing their service capacity. There is not the long range of efficient speed-curve running which characterizes the continuous current motor, the change from accelerating to free-running being almost sudden. "The equipment weight, moreover, for suburban service is almost as high as in the single-phase system." "The polyphase system is practically confined to trains drawn by a single locomotive or motor coach. A small difference in the size of the driving wheels would result in a considerable inequality in the loading of the motors, and if some of the wheels are new and others old—as would be sure to be the case at times with multiple unit trains—some of the motors would do all the work and might even drive others as generators. The difference in size of the wheels is almost without effect in the continuous current and single-phase systems." For a class of service to be suitable for this system of operation, it must be such as will provide the motors with an efficient load during the greater part of the time they are taking power. A mountain line can be satisfactorily operated by polyphase motors, since the continuous grades furnish a sufficient load and there is no need to carry excessive motor capacity to provide for acceleration. In fairly level country, goods or other service, in which stops are infrequent, and the acceleration therefore of small importance, might very well be operated by the polyphase system. High-speed long-distance service is particularly suitable, the high resistance making the grade resistance of relatively smaller importance, so that during free-running the motors can be arranged to operate near the load of highest efficiency.

In his conclusion of the whole matter Mr. Carter showed that it was not the possible saving in operating expenses that constituted the case for the electrification of suburban lines; for a converted line to handle electrically the present traffic would not create a sufficient saving in operating expenses to pay 1 per cent. on the capital sunk in conversion. Taking all things into consideration the author thought the continuous current system by far the most suitable for English suburban service. He remarked that the Liverpool-Southport service, in which the schedule speed is 30 miles per hour, with stops less than a mile and a quarter apart, could hardly be effectively and efficiently operated otherwise than by the continuous-current system.

Some of the objections to this system were discussed, and it was stated that the best system of operation is a matter for investigation in particular cases, depending upon the considerations raised in an early part of the paper.

The author said that there did not appear to be much prospect for exceedingly high-speed lines in England for some time to come; and that the operation of main line trains would not be sensibly improved by electrification. Electrical operation it was contended was only economically feasible for those classes of traffic in which some special service advantage resulted.

The Whitney Self-Adjusting Chill.

The accompanying illustrations show sections of the Whitney self-adjusting chill, invented and made by John R. Whitney, Farmington, Conn. This device is termed self-adjusting because it is constructed to adjust itself automatically to all of the conditions involved in casting wheels. With the solid chill, when the molten metal strikes the inner surface of the chill, that surface immediately expands in the direction of its circumference, and as the circumference of this surface cannot enlarge until the whole thickness of the chill has become heated, an enormous pressure is exerted to compress the material of which the chill is made. By careful experiments, such expansion has been found to be at least 0.01 in. in every inch. The inner circumference of a 33-in. chill being about 100 in., its total expansion must therefore be about 1 in., and the metal of the chill must be compressed to that extent as soon as it is heated by the molten metal. As a consequence, the chill is at once subjected to a great strain, tending to break it in two. It also becomes warped out of a true circular shape, and on cooling the inner surface becomes broken into many fissures. For this reason, it is necessary to frequently renew solid chills.

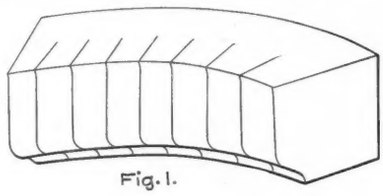


Fig. 1.

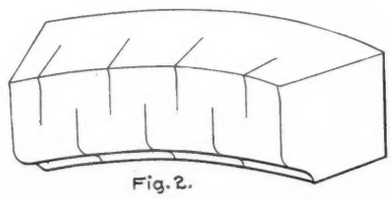


Fig. 2.

The Whitney Self-Adjusting Chill.

To remedy these difficulties, somewhat more than twenty years ago a so-called contracting chill was introduced. It was a kerfed chill, and from the nature of its construction, every form of it was much larger in diameter and much heavier in weight than the solid chill. But in this form of chill, when the molten iron strikes the inner surface, the segments of which it is composed expand laterally, or in the direction of the circumference, as well as radially, or in the direction of the diameter. This lateral expansion amounts in all to about 1 in., while the radial expansion is only $^1/_{32}$ in. The expansion in the direction of the circumference closes up the kerfs, the inner surface is not disintegrated or broken into fissures, and all strain due to the difference of temperature between the inner and outer surfaces is removed. The inner surface thus retains its original size and shape until all of the required chilling effect upon the wheel has been produced; then, when the chill has become

heated through, it expands as the wheel cools and contracts. It is claimed that more than half a million wheels have been cast in chills so kerfed, and that the treads of the wheels so cast were so smooth that not one of them required the least grinding. Chills made in this way, it is claimed, if carefully handled, are as accurately round after ten years' use as when they came off the lathe.

The Whitney self-adjusting chill is a modified and improved form of the contracting chill, by which the size, weight and cost are reduced to practically the same as the solid chills in ordinary use, without lessening in the least any of the valuable features of the contracting chills. Two forms of the Whitney self-adjusting chill are shown in Figs. 1 and 2. The inner surface of the form shown in Fig. 1 is composed of a number of segments, formed by kerfs cut all the way through from the upper to the lower face; while in the form shown in Fig. 2 the segments are formed by cutting the kerfs half way through, and alternately from the upper and lower faces, as shown. The kerfs in both cases are cut in the process of casting, and not afterwards by sawing. They are made by inserting in the chill mold sheets of asbestos paper, and are only about 0.01 in. wide throughout. They extend into the chill for at least 2 in. from its inner face. This new chill is interchangeable with any other chill in use without any alteration in the other parts of the flask.

High Speed Experiments in Prussia.

The Prussian State Railroads are about to resume the experiments with steam locomotives at high speeds. In 1904, with superheated steam, a speed of 84 miles an hour was reached on the Military Railroad (where the highest known speeds had been made with electric motors). This speed was made with a train of three 8-wheeled cars; 80 miles an hour with six such cars. The new tests will probably be made on tracks between Spandau and Hanover. Tests with new power brakes are reported to have been satisfactory for freight trains. The tests with high-speed passenger trains are not yet completed, but it is hoped that by next fall a satisfactory brake will be developed for the highest speeds.

The estimates of the earnings and expenses of the Prussian State Railroads for the current year, now near its end, submitted to the Diet Jan. 9, are that compared with the previous year there will be an increase of $14,446,000 in gross earnings, and an increase of $11,376,000 in working expenses, so that the increase in net earnings will be only $3,070,000, which is a very moderate gain for a business amounting to $380,000,000. Higher prices of materials and better pay for employees have caused expenses to grow out of proportion to the growth in traffic. The profits of the state railroads this year will contribute about $49,000,000 to the national income.

For the coming year (beginning with next April) the Minister of Finance estimates an increase of $27,489,000 in gross earnings and of $15,946,000 in working expenses, leaving a gain of $11,543,000 in net. Of the increase in expenses, $6,660,000 will go to the employees. On capital account the railroads ask for $34,750,000, and $23,800,000 are wanted for new freight cars alone. This for 21,685 miles of railroad.

Train Accidents in the United States in January.[1]

xc, 2d, Auburn Junction, Ind., a freight train of the Baltimore & Ohio backed into a freight of the Vandalia at the crossing of the two roads, and 14 cars were wrecked. One brakeman was injured.

nux, 3d, Southern Railway, Fair Forest, S. C., a freight train was derailed and the engine and several cars were overturned. The engineman and fireman were killed and several other trainmen were injured.

dr, 3d, Tallulah Falls road, Clayton, Ga., passenger train No. 9 was derailed at a point where the road-bed had been weakened by rain, and three cars were overturned. The conductor and three passengers were injured.

rc, 3d, Chicago, Milwaukee & St. Paul, Chicago, Ill., rear collision of freight trains, wrecking the caboose. Ten men in the caboose were injured.

rc, 4th, 3 a. m., Baltimore & Ohio, Chester, Pa., a freight train which had been obliged to slacken speed on account of another train ahead of it, was run into at the rear by a fast freight, making a bad wreck. A conductor was killed.

bc, 5th, night, Gulf, Colorado & Santa Fe, Cleburne, Tex., butting collision of passenger trains, damaging both engines. Several passengers were slightly injured. The collision occurred in the yard, and one of the enginemen says that he was blinded by the electric headlight of the other engine.

unx, 5th, 11 p. m., Southern Pacific, Palisade, Nev., fast mail train No. 9 was derailed and two trainmen and 10 mail clerks were injured, one of the latter fatally.

bc, 6th, Pennsylvania road, Corry, Pa., butting collision between passenger train No. 4 and empty engine No. 900 wrecking both engines and ditching many cars. Both firemen and one engineman were killed and eight passengers were injured.

unf, 6th, Boston & Maine, Walloomsac, N. Y., a passenger train was derailed at a misplaced switch, and the engine and first two cars were badly damaged. The engineman, fireman and five passengers were injured, the engineman probably fatally. It is believed that the switch had been maliciously misplaced.

nux, 6th, Philadelphia & Reading, Brantsville, Pa., a freight train was derailed and 25 cars were wrecked; the conductor and engineman were killed and several other trainsmen were injured.

xc, 7th New York Central & Hudson River, Grand Central Station, New York City, a train of empty passenger cars, being run into the headhouse of the station by gravity, were allowed to run too fast and collided violently with three empty passenger cars standing at the end of the track. The car at the end of this string of three was pushed over the bumping post and against the doorway of the waiting room, killing a man who was trying to enter the door.

bc, 8th, 3 a. m., New York Central & Hudson River, Geneva, N. Y., butting collision of freight trains, wrecking both engines and seven cars. One engineman was killed and one other trainman was injured.

unx, 8th, Texas & New Orleans, Dunagan, Tex., a work train drawn by two engines was derailed and one of the engines fell down a bank. A fireman was killed and one other trainman was injured.

nux, 11th, Terminal Railroad of St. Louis, St. Louis, Mo., a sleeping car in a train of the Wabash road was derailed while passing over the elevated structure at Carr street, and after running a short distance on the sleepers fell over to the right and dropped to the pavement, about 15 feet below. Nine of the 13 passengers in the car were injured.

xc, 12th, New York Central & Hudson River, Liverpool, N. Y., collision between a freight train and a train consisting of an engine and caboose, switching on the main track, damaging several cars. One brakeman was killed and three other trainmen were injured, two probably fatally.

bc, 13th, Louisville & Nashville, Monroe, Ala., butting collision between a special passenger train and a logging train; three passengers injured.

*xc, 13th, Southern Railway, Lawrenceburg, Ky., a freight train backing in the yard broke in two and the rear portion ran uncontrolled down grade some distance and collided with a passenger train, making a bad wreck. A tank car filled with oil and two loaded box cars took fire and were burned up. One fireman was kille and four other trainmen were injured.

eq, 13th, Yazoo & Mississippi Valley, Wakefield, La., a freight car in a mixed train was derailed by the breaking of the flange of a wheel, and three persons were injured.

unx, 13th, Branchville & Bowman, Bowman, S. C., a train consisting of a caboose, a locomotive with the tender in front, and five freight cars, made up in the order named, was derailed on a curve, and the engine and two cars fell over into a pond. Two passengers were injured.

*bc, 15th, 11 p. m., New York, Susquehanna & Western, Paterson, N. J., butting collision of freight trains, wrecking both engines and several cars. The wreck took fire and was mostly burned up. One trainman was killed and three others were injured. There was a dense fog at the time.

eq, 17th, Darien & Western, Glennville, Ga., a freight train was derailed by a brake beam which fell on the track, and several cars were wrecked. Two men were killed and four injured.

dn, 17th, Southern Railway, Cookeville, Tenn., a freight train was derailed at a misplaced switch; one brakeman was killed and two other trainmen were injured.

unf, 17th, Colorado & Southern, Uneva Lake, Col., a passenger train was struck by a snowslide and four passenger cars were overturned; 12 persons were injured.

unx, 17th, Central of New Jersey, Newark, N. J., a passenger train was derailed at a switch and the engine was overturned. The fireman was fatally injured.

rc, 18th, Central of New Jersey, Bound Brook, N. J., rear collision of passenger trains, badly damaging four passenger cars. Several passengers were injured.

bc, 18th, Baltimore & Ohio, Newton Falls, Ohio, butting collision of freight trains, wrecking both engines and 13 cars. One fireman

[1]Accidents in which injuries are few or slight and the money loss is apparently small, will, as a rule, be omitted from this list. The official accident record, published by the Interstate Commerce Commission quarterly, is regularly reprinted in the *Railroad Gazette*. The classification of the accidents in the present list is indicated by the use of the following

ABBREVIATIONS.

rc	Rear collisions.
bc	Butting collisions.
xc	Miscellaneous collisions.
dr	Derailments; defects of roadway.
eq	Derailments; defects of equipment.
dn	Derailments; negligence in operating.
unf	Derailments; unforeseen obstruction.
unx	Derailments; unexplained.
o	Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more passengers.

and an unknown man were killed and one other person was injured.

bc, 19th, Seaboard Air Line, Mina, Ga., butting collision between a freight train and a switching engine, wrecking both engines and 10 cars. The engineman and fireman of the switching engine and a telegraph operator were killed and two other employees were injured. It is said that the switching engine was wrongfully occupying the main track on the time of the freight train.

xc, 19th, New York, New Haven & Hartford, Hartford, Conn., collision of passenger trains at a meeting point, one of the trains running beyond the point where it should have stopped to clear the side track. Two cars were ditched and several passengers were slightly injured. The engineman (63 years old) of the train which was at fault was not injured by the accident, but died of apoplexy the next day.

*rc, 21st, Boston & Maine, Ayer, Mass., rear collision of freight trains, damaging one engine and a caboose. The caboose took fire from the fire in its stove, which was overturned, and with several cars was burned up. One fireman was injured.

unf, 21st, Western of Alabama, Montgomery, Ala., a passenger train was derailed at a switch, which it is believed had been maliciously loosened, and one baggage car and one passenger car were overturned; 14 passengers were injured, most of them slightly.

unf, 21st, Chicago, Rock Island & Pacific, Riceville, Ark., passenger train No. 3 was derailed at a point where the track had been weakened by heavy rains and several cars were damaged. Seven passengers were injured.

rc, 22d, Central of New Jersey, Netherwood, N. J., an empty engine, eastbound, ran into the rear of a preceding freight train which was switching on the main track, and four cars were derailed. A part of the wreck lodged on the westbound track and a westbound express train ran into it, and the cab of the locomotive and the sides of all the passenger cars in the train were badly damaged. Four employees were injured. There was a dense fog at the time. It is said that the empty engine had disregarded distant and home signals set against it .

unf, 22d, 1 a. m., Chicago & Eastern Illinois, Hillsdale, Ind., a freight train drawn by two engines was derailed at a washout, and both engines and several freight cars were wrecked. One fireman was killed and four other trainsmen were injured.

*o, 22d, Missouri, Kansas & Texas, Holland, Tex., a private car in a passenger train too kfire from the range in its kitchen and was destroyed. The occupants of the car escaped, but lost all of their clothing.

rc, 23d, Atchison, Topeka & Santa Fe, Glendora, Cal., a local passenger train, just starting from the station, was run into at the rear by a following express train, and the rear car was crushed for half its length. The conductor and 14 passengers were injured, most of the passengers slightly. The express train approached on a descending grade, and the danger of a collision was seen by the conductor of the local, and he had started his train for the purpose of trying to avoid it. It is said that a block signal operator gave a false clear signal to the express.

unf, 24th, Central New England, Ore Hill, Conn., an empty engine ran against a large tree which had fallen across the track and the cab of the locomotive was wrecked, fatally injuring the fireman and a brakeman. The tree had been partly cut the day before, preparatory to felling it, and it was held upright by a rope. A high wind arose in the night and so strained the rope that it gave way, allowing the tree to fall upon the track.

*rc, 26th, Missouri Pacific, Jefferson City, Mo., a freight train standing at the station was run into at the rear of a following passenger train and 10 freight cars were badly damaged. The wreck took fire and was mostly burned up. Of the 200 passengers on the passenger train many were bruised, but none seriously hurt.

xc, 26th, Chicago, Burlington & Quincy, Omaha, Neb., a switching engine in the yard backed into the side of a freight train passing on the main track, damaging the engine and wrecking one freight car. The fireman was killed.

xc, 26th, 8 p. m., Gulf, Colorado & Santa Fe, Bellville, Tex., a freight train, moving backward, collided with a switching engine, damagnig the caboose. The fireman of the switching engine was badly scalded by steam from the boiler of his engine, which, it is said, exploded immediately after the collision.

nuf, 26th, 7 p. m., Central Vermont, Bolton, Vt., a passenger train ran over a misplaced switch and into a side track, and continued some distance on the side track without being derailed, but on reaching a second facing point switch the engine ran upon one track and the tender the other, and the tender and two cars were derailed and fell against some freight cars. The main track switch had been misplaced, and the lamp changed so that it indicated all right. It is said that no person was injured.

unx, 27th, 1 a. m., Atlanta & West Point, East Point, Ga., passenger train No. 97 was derailed, and the engine and several cars were ditched. The engineman was injured.

dr, 28th, 1 a. m., St. Louis & San Francisco, Dora, Ala., passenger train No. 204 was derailed by a broken rail and the baggage car was overturned. Three passengers and three trainmen were injured.

rc, 29th, 4 a. m., Southern Railway, Campobello, N. C., a freight train which was stalled on a grade, was run into at the rear by a following freight, and the conductor, who is said to have been sleeping in the caboose, was killed.

bc, 29th, Lake Shore & Michigan Southern, Doughton, Ohio, butting collision of engines; four trainmen injured.

*bc, 29th, Atchison, Topeka & Santa Fe, Edelstein, Ill., butting collision between a passenger train and a freight, wrecking both engines and several cars. An express car and its contents took fire and were burned up. Three men were killed and a fourth fatally injured. It is said that a block signal operator had slept at his post and allowed a freight train to pass without being aware of its passage.

bc, 29th, 11 p. m., Great Northern, Columbia Falls, Mont., butting collision between westbound passenger train No. 1 and eastbound passenger train No. 2, damaging the engines and express cars of both trains. Two firemen and one express messenger were killed.

bc, 29th, Cleveland, Cincinnati, Chicago & St. Louis, Lexington, Ind., butting collision between passenger train No. 34 and a freight train, badly damaging both engines and several cars. Five trainmen and four passengers were injured.

bc, 30th, Seaboard Air Line, Columbia, S. C., butting collision between northbound passenger train No. 66 and a southbound freight train, badly damaging both engines and several cars, and wrecking the mail car. One engineman, one fireman and two mail clerks were killed and three other trainmen were injured.

eq, 30th, Atchison, Topeka & Santa Fe, Laura, Ill., passenger train No. 1 was derailed by a broken wheel, and the first four cars were overturned. The conductor and two passengers were injured.

unx, 30th, Missouri, Kansas & Texas, Colbert, I. T., a freight train was derailed and the tender, three freight cars and the caboose were ditched. Six passengers were injured, most of them slightly.

bc, 31st, 7 a. m., Delaware & Hudson, Delanson, N. Y., butting collision between a passenger train and a train consisting of a passenger car, occupied by laborers, pushed by a locomotive. One of the laborers was killed and nine were injured.

xc, 31st, 9 p. m., Delaware & Hudson, Delanson, N. Y., passenger train No. 85 collided with an empty engine, and one fireman was killed.

unf, 31st, Louisville & Atlantic, Foster's, Ky., a freight train was derailed by running over a cow, and the engine fell down a bank. The engineman was killed and the fireman and one brakeman were fatally injured.

Foreign Railroad Notes.

The Bavarian State Railroads have increased the privilege of free traveling for the corps of employees, so that 12 such free trips in a year may be had hereafter. Workmen not belonging to the regular corps of employees may have a pass for their vacation, and when they have served three years may have passes for four trips each year.

In 1904 during a drought in Silesia the woods caught fire from locomotive sparks, and great destruction followed of forests belonging partly to individuals and partly to the Prussian Government. The amount paid by the railroad department for damages was $1,050,000, but it received $325,000 for what was left standing after the fire. The most notable fact in the matter is that all claims were settled without litigation.

Two of the Prussian State Railroad directories (there are 11 in all) have forbidden all employees to drink alcoholic beverages while on duty. The order of the Minister, in force on all the State lines, applied only to trainmen and such station and track men as affect train service.

Karl von Thielen, for eleven years, until 1902, as Minister of Public Works the head of the Prussian State Railroad management, died in Berlin Jan. 10, at the age of 74. Thielen was the son of an army chaplain, studied law and entered the state service, and as early as 1864 the state railroad service. From 1867 to 1880 he was an officer of a railroad company, but returned to the state service when the government acquired his company's lines, and in 1891 succeeded Maybach, under whom the state system was chiefly acquired, as Minister. His funeral was held in one of the great railroad stations of Berlin.

Last October as an express train was standing on main track at Duisburg, in Prussia, the station assistant signalled line clear to another express approaching on the same track, the result of which was a collision with two men killed and two others severely injured. The station assistant had been in the service since the age of 14, and had a record as a faithful and trustworthy man. He recognized his blunder, delivered himself up, and on trial was sentenced to four months' imprisonment.